3-89

# FRENCH LIMITED SITE

CROSBY, TEXAS

# HYDROGEOLOGIC CHARACTERIZATION REPORT

# APPENDICES

SUBMITTED TO:

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 6

AND

THE TEXAS WATER COMMISSION

MARCH, 1989

2002955

Applied Hydrology Associates, Inc.

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BOOKMARK

023632

# APPENDIX A

PUMP TEST OF WELL REI-3-3 (August 11, 1986)

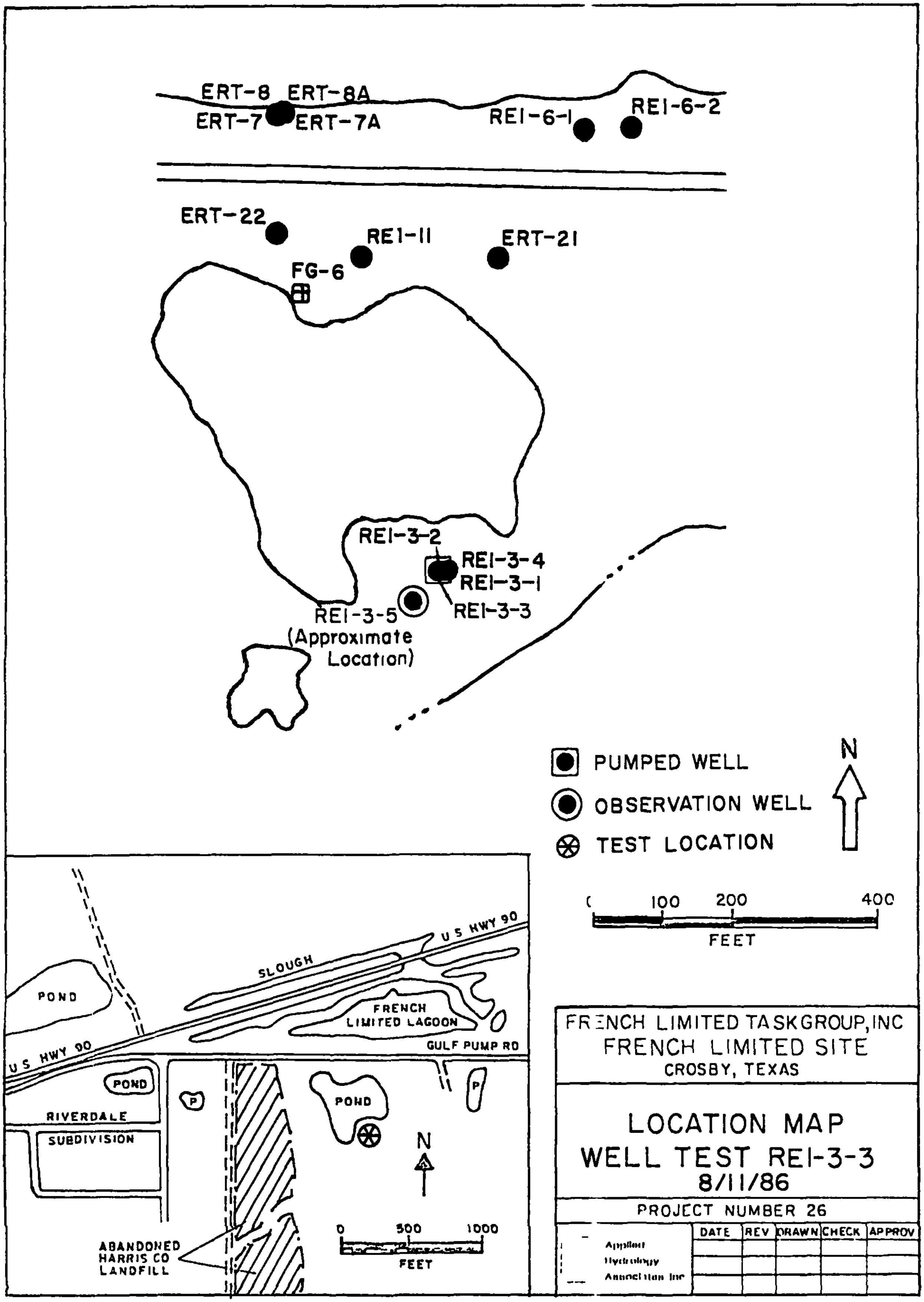
Well REI 3-3 was first tested in November, 1985 with results provided in the RI Report Questions were raised about the method of interpretation and the number of monitoring wells required for interpretation An additional observation well, REI-3-5, was completed during the 1986 field program and a new pump test was performed The initial plan was to use the new well, REI-3-5, as the pumped well The well did not produce enough to run a sustained pump test Consequently, REI-3-3 was selected as the pumped well

The REI-3-3 well was pumped at a fairly steady rate of 3 0 gpm for 750 minutes A slightly higher pumping rate of 3 2 5o 3 4 gpm was recorded about 50 minutes into the test Water levels in the pumped well and two observation wells, REI-3-5 and an un-numbered piezometer, were monitored manually using conventional well sounders Measurement accuracy is about +/- 0 02 feet the water level response of the three wells during the drawdown portion of the test is shown in Figures A-1, A-2, and A-3

The water level drop noted in all wells after about 50 minutes probably reflects the adjustment of pumping rate noted above The flattening of the water level response observed in all wells following this drop is believed to be attributale both to the onset of delayed yield effects (Boulton, 1963) and recharge effects from an adjacent pond about 70 feet from the pumping well It is difficult to isolate the effects of these two influences

The most reliable part of the test for analysis of hydrogeologic characteristics is the early time data prior to the noted increase in pumping rate and also before the onset of recharge or delayed yield effects Analysis of the responses in the two observation wells were performed using the type-curve match method described by Boulton (1963) developed for non-steady state response to pumping in unconfined aquifers Actually, for early time matches before the onset of delayed yield effects the Boulton type scurves are identical to the Theis (1935) type curve The analysis indicates a transmissivity for the uppermost part of the upper alluvial zone of about 500 gpd/ft (0.72 $cm^2$/sec) For a saturated thickness of about 19 feet, an average hydraulic conductivity of about $1.2 \times 10^{-3}$ cm/sec is indicated for this unit. The storage coefficient calculated for the unit is about 0.003 which is reasonable for unconfined aquifer units (Freeze and Cherry, 1979).

023614


ERT-8
ERT-8A
ERT-7
ERT-7A
REI-6-1
REI-6-2
ERT-22
REI-11
ERT-21
FG-6
REI-3-2
REI-3-4
REI-3-1
REI-3-3
REI-3-5
(Approximate Location)
PUMPED WELL
OBSERVATION WELL
TEST LOCATION
N
0 100 200 400
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
U S HWY 90
POND
RIVERDALE
SUBDIVISION
P
POND
P
N
ABANDONED HARRIS CO LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST REI-3-3
8/11/86
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK
APPROV

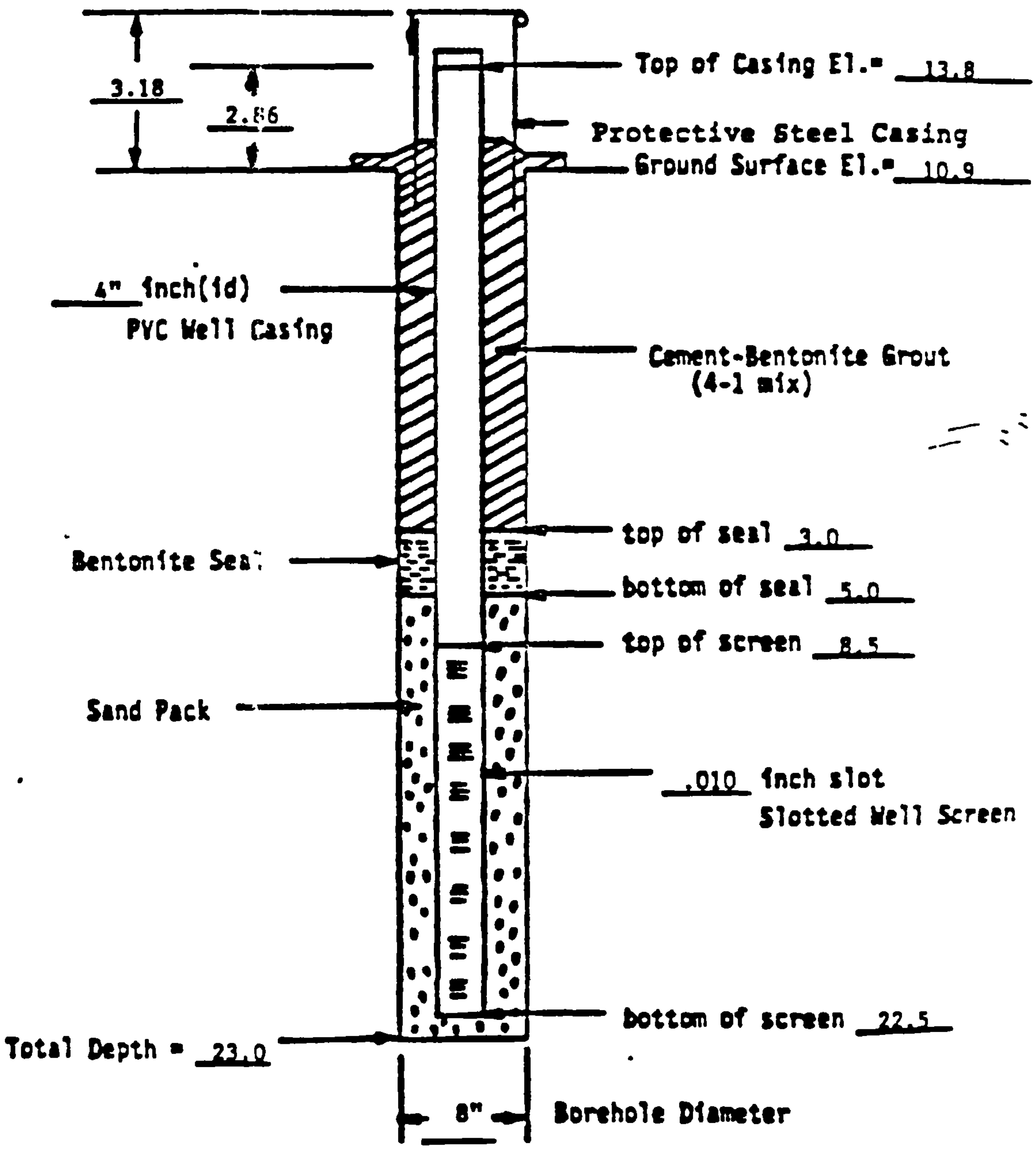
023635

## Details of Monitor Well Construction

Project Name: FRENCH LIMITED SITE    Boring Number: REI:3-3

Project Number: 275-02    Date Installed: 2-24-84

Water Level Measurement: 5.60 (El. = 8.2 on 4-12-84)




REI

023636

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client FRENCH LIMITED TASK FORCE
Boring # REI-3-3
Architect Engineer C.Itin
Job # 27511
Project Name French Site
Drawn By JB
Project Location Crosby, Texas
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 5/13/85 Hammer Wt 140 lbs
Date Completed 5/13/85 Hammer Drop 30 in
Drill Foreman G.Littel Spoon Sampler OD 2 in
Inspector JB Rock Core Dia - in
Boring Method SFA Shelby Tube OD 3 in

TEST DATA

| SOIL CLASSIFICATION<br>SURFACE ELEVATION – (10.9) | Stratum Depth | DEPTH SCALE | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N Blows/Ft | Unconfined Compressive Strength qu Tons/Ft² / Pocket Penetrometer qu Tons/Ft² * | Permeability X 10⁻ cm/sec | Natural Dry Density lbs/cu ft | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY SAND, fine grained, tan (SM) | 4.0 | | | | | | | | | | | |
| CLAYEY SILTY SAND, fine grained, gray (SC) | 7.0 | 5 | | | | | | | | | | |
| SAND, fine to medium grained gray (SP-SW) -200 = 2.3% | | 10 15 | | | | | | | | | | |
| | | 20 | 01 | SS | 33 | | 14 | | | | | |
| | | | NR | ST | 0 | | | | | | | |
| Boring Terminated at 23' (El.= -12.1) | | 25 | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 5.8 FT
▼ AFTER HRS FT
WATER ON RODS FT

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

023637

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

Sheet 1 of 1

# LITHOLOGIC LOG AND CONSTRUCTION OF REI 3-5

Client: FRENCH LTD
Project Name: French Ltd
Project Location: Crosby, Texas
Job No: 275-14 Boring No: REI 3-5
Logged By: P. Mann, Hydrogeologist
Approved By:
Drilled By: Southwest Labs/Gulf Coast Coring

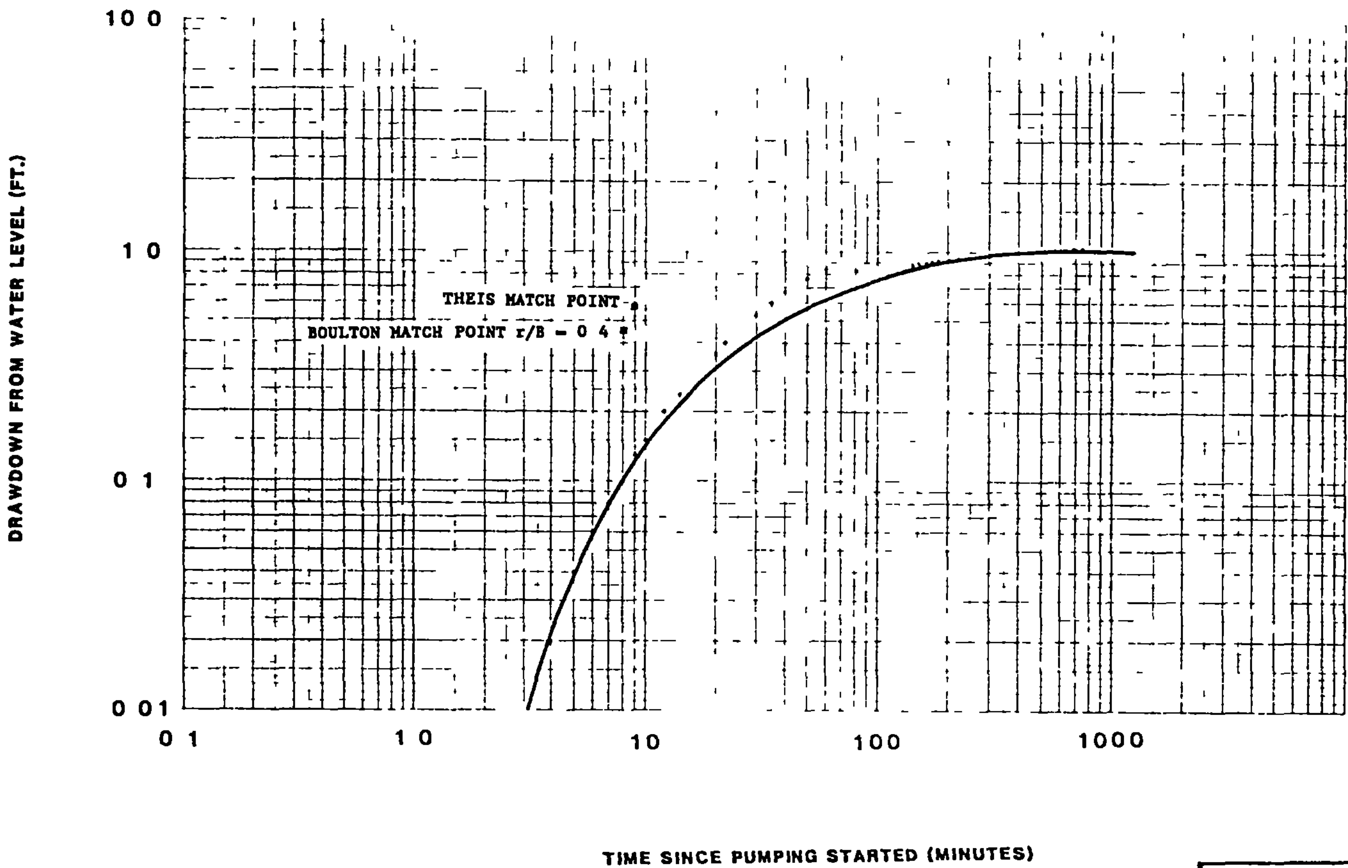
DRILLING AND SAMPLING INFORMATION
Date Started: 7/15/86 Date Completed: 7/18/86
Method: Rotary Wash Total Depth: 23 0'

WELL COMPLETION INFORMATION
Screen Dia: 4 in Length: 15 75'
Slot Size: 010 in Type: PVC Schedule 40
Casing Dia: 4 in Length: 8 35'

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | TOPSOIL, CLAYEY SILT TO SILTY CLAY, brown and gray, mottled, with roots | 4 0 | 0-2<br>2-4 | ST<br>ST | 1 10<br>1 10 | | | W L Collected 8-11-86 |
| 5 | CLAYEY SAND, brown and gray, mottled, moderately soft, moist | 6 0 | 4-6 | ST | 1 40 | | | |
| | SANDY CLAY WITH SILT, brown and gray, mottled, firm | 7 1 | | | | | | |
| 10, 15, 20 | SILTY SAND TO SAND, fine to coarse grained, gray, wet<br>12 0 to 14 5' with pebbles (fine gravel), subrounded<br>below 14 5' brown to grayish brown, mostly medium grained<br>at 16-18' interval caving sands making continuous sampling difficult, drilled to 21 0' and then sampled | 22 3 | 6-8<br>8-10<br>10-12<br>12-14<br>14-16<br>16-18 | ST<br>SS<br>SS<br>SS<br>SS<br>SS | 1 25<br>1 60<br>1 50<br>1 50<br>1 60<br>1 60 | | | |
| | S_TY CLAY, brown and gray, mottled, moderately firm | 23 0 | 21-23 | ST | 1 90 | | | |
| 25 | BORING COMPLETED TO 23 0' DEPTH USING 3-1/2' BIT ON 7/15/86 ON 7/18/86, BOREHOLE WAS REAMED OUT USING 7-7/8" BIT AND THEN THE MONITOR WELL WAS INSTALLED | | | | | | | |

SAMPLER TYPE
S DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING



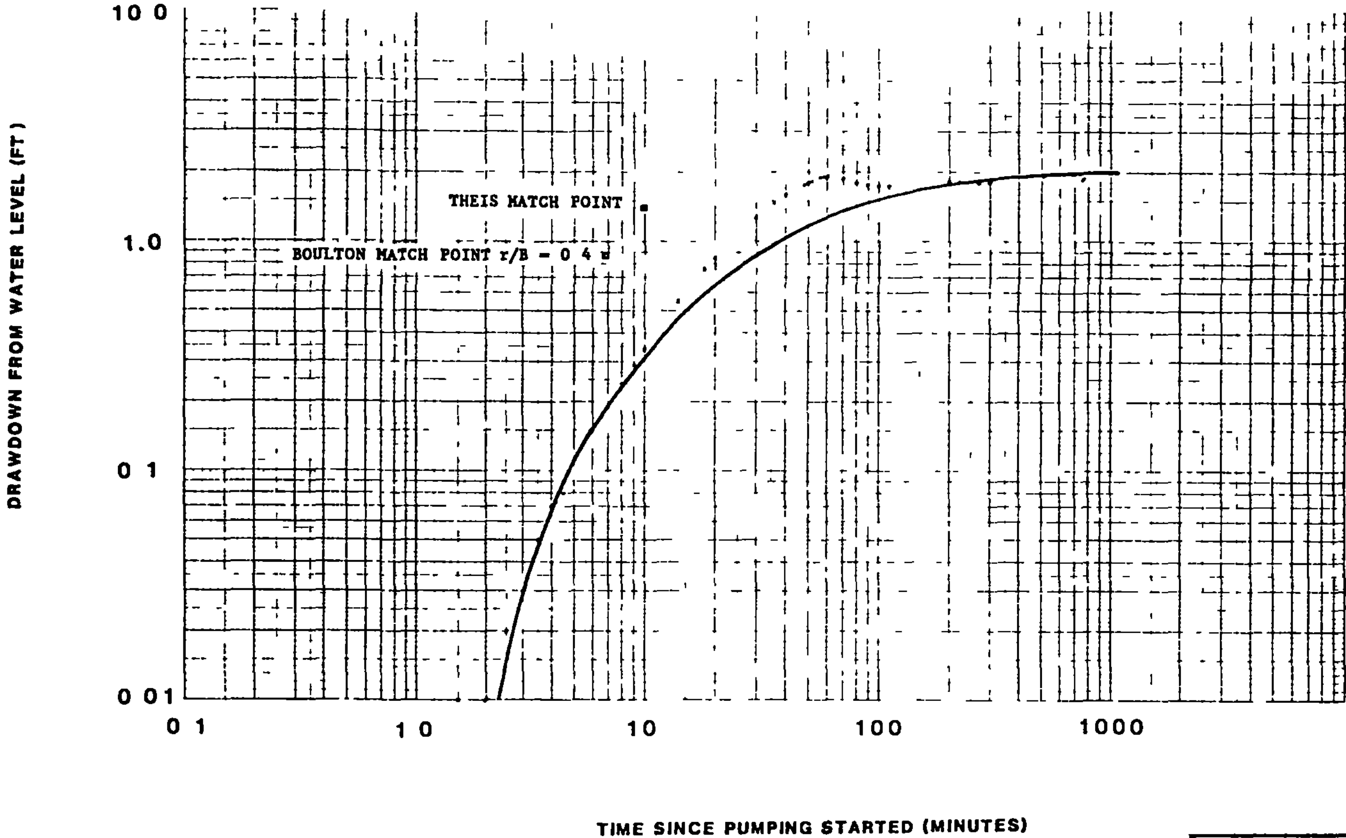

**FRENCH LIMITED PROJECT**
CROSBY TEXAS

**FIGURE A-1**
**WATER LEVEL RESPONSE PLOT**

OBSERVATION WELL REI 3-5 PUMPED WELL REI 3-3
DATE(S) 8/11/86 to 8/12/86 COMMENTS

| PROJECT No FR86-006 | DATE 11-26-86 | REVISION 1 |
| --- | --- | --- |

PREPARED BY APPLIED HYDROLOGY ASSOCIATES DENVER CO

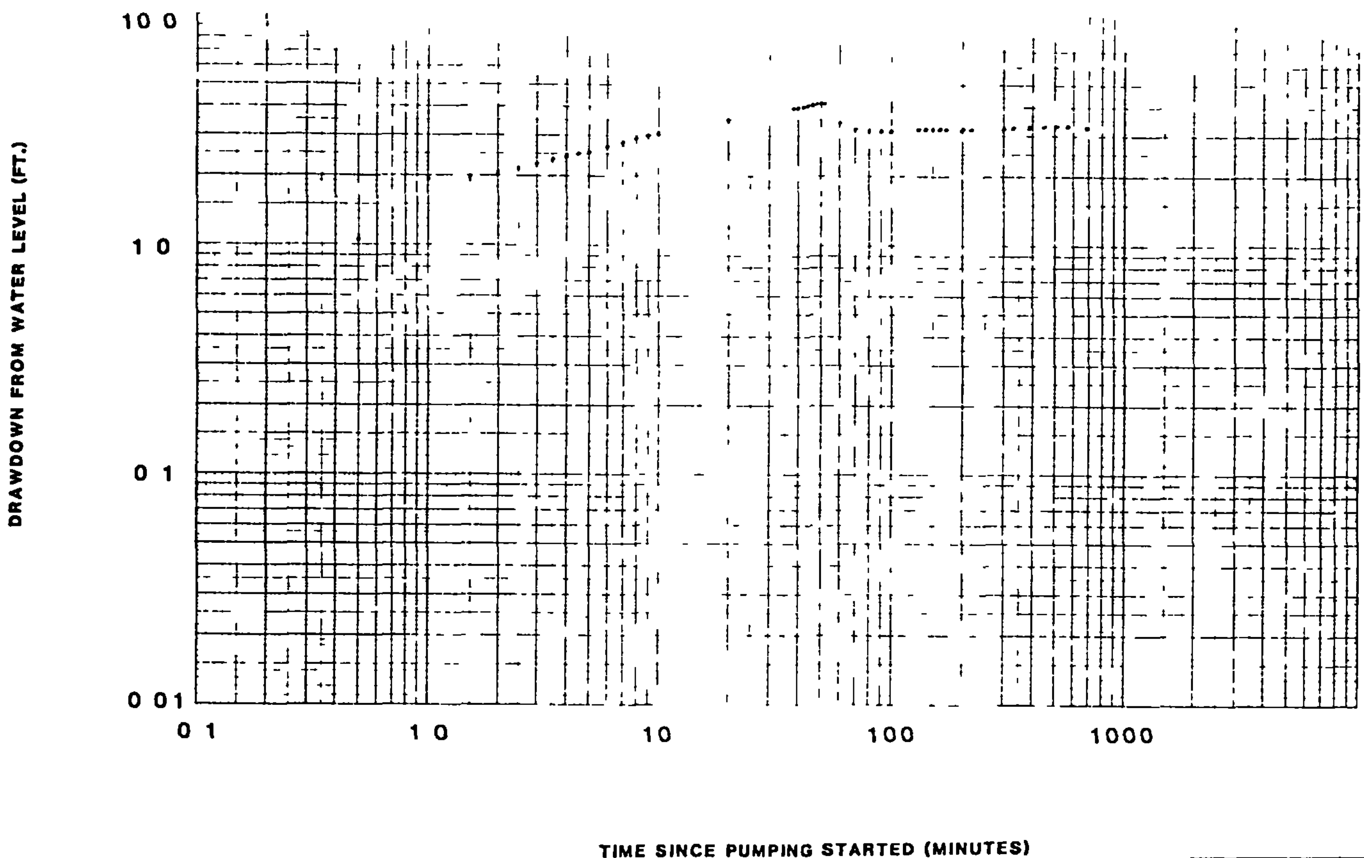



| FRENCH LIMITED PROJECT | | |
|---|---|---|
| CROSBY, TEXAS | | |
| FIGURE A-2 | | |
| WATER LEVEL RESPONSE PLOT | | |
| OBSERVATION WELL REI P-3-3 PUMPED WELL REI 3-3 | | |
| DATE(S) 8/11/86 to 8/12/86 COMMENTS | | |
| PROJECT No FREL-006 | DATE 11-26-86 | REVISION 1 |

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

A-7

023639




**FRENCH LIMITED PROJECT**
CROSBY TEXAS

**FIGURE A-3**
**WATER LEVEL RESPONSE PLOT**

OBSERVATION WELL REI 3-3 PUMPED WELL REI 3-3
DATE(S) 8/11/86 to 8/12/86 COMMENTS

| PROJECT No PR86-006 | DATE 11-26-86 | REVISION 1 |
|---|---|---|

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER, CO

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023641

# APPENDIX B

# RESULTS OF THE SHALLOW ALLUVIAL AQUIFER

# PUMP TESTING PROGRAM

# MAY-AUGUST, 1988

FRENCH LIMITED SITE, CROSBY, TEXAS

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## B-1 PUMP TEST OBJECTIVES

This appendix provides the description and analyses of the upper alluvial zone aquifer tests that were completed under the direction of Applied Hydrology Associates Inc in 1988 These tests were conducted in two stages preliminary short term tests conducted on site between May 24 and May 26, 1988 and longer term (6-to 8-hour) testing program conducted on site from August 5 through August 15, 1988 Prior to this effort, testing of the upper alluvial zone included only slug tests and several pump tests at the REI-3 well location The pump tests performed during 1988 and described in this appendix provide the additional information needed to characterize the spatial variation in hydraulic conductivity within the upper alluvial zone These results help support the assessment of groundwater impacts that may occur during bioremediation testing or final remediation of the French Limited Lagoon. The pump testing results will also facilitate the design of groundwater recovery systems that may be installed to remediate groundwater contamination

The preliminary tests were conducted during the monthly sampling of monitoring wells in the upper alluvial zone in the vicinity of the French Limited site The purpose of these tests was to provide a preliminary assessment of characteristics on a large number of wells from which to plan longer, more definitive tests on a select number of wells

A work plan for the longer term testing was prepared and submitted on June 13, 1988 An update of this work plan dated August 3, 1988 was prepared partly in response to questions and concerns raised by Kathleen O'Reiley of the Region VI office of the U S EPA The update also includes details that were not discussed in the work plan including the use of control measurements on select wells and the recommended monitoring intervals A number of modifications to the testing program were also made in the field either in response to the sustainable pumping rates which were generally lower than anticipated or to address concerns raised by personnel of the EPA and Jacobs Engineering concerning test locations A summary of the tests proposed in the work plan and the subsequent modifications of the testing program is provided in Table B-1.

## B-2 UNCONFINED AQUIFER PUMP TEST ANALYSES

Analysis of unconfined aquifer pump test results is possible using a variety of equations and type curves that have been developed to approximate the response of an unconfined aquifer to radial flow to a pumping well Earlier solutions were derived by invoking the Dupuit assumptions (Bear, 1979). Jacob (1963) derived a solution for unconfined flow that was equivalent to the Theis (1935) solution by invoking the Dupuit assumptions and using the following adjusted drawdown:

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

# TABLE B-1

## FRENCH LIMITED SHALLOW AQUIFER PUMPING TESTS

ORIGINAL WORK PLAN TESTS:

| PUMPED WELL | OBSERVATION WELLS |
|---|---|
| REI-10-3 | ERT-1, ERT-1A, ERT-4, ERT-4A, REI-10-2, REI-P10-2, REI-10-4,REI-P10-4 |
| ERT-7 | ERT-8, ERT-7A, ERT-8A |
| ERT-20 | ERT-20 (Single-Well Test) |
| ERT-21 | ERT-21 (Single-Well Test) |
| ERT-29 | ERT-28, ERT-30 |

MODIFICATIONS TO ORIGINAL WORK PLAN

| | |
|---|---|
| ERT-10-2 | Short term step drawdown test |
| ERT-10-3 | Short term step drawdown test |
| ERT-10-4 | Short term step drawdown test |
| ERT-10 | Long term pumping test (replaced ERT-10-3 Test)<br>Monitor wells ERT-9, ERT-9A, ERT-10A |
| ERT-22 | Single well test |

The Dupuit assumptions require that vertical gradients are negligible Anisotropy with respect to the vertical dimension and the increase in the slope of the water table around a pumping well cause the actual drawdowns to deviate from that determined based on the Dupuit assumptions

For many unconfined aquifer tests, the drawdown adjustment allows test results to be interpreted by the three methods most commonly used for calculating aquifer coefficients from time-drawdown data the Theis (1935) curve matching method, the Theis (1935) recovery method, and the Cooper and Jacob (1946) method The Theis method involves curve matching on a log-log plot It is less restrictive but is not well suited to single well tests where well efficiency and the assumed radial distance can significantly influence the results The Cooper and Jacob method involves straight line interpretations from a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The Cooper and Jacob method is based on an approximation of the Theis equation The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where r is the radial distance between the pumping well and the observation well (feet),
S is the storage coefficient (dimensionless)
T is transmissivity ($feet^2$/day), and
t is the time since pumping started (days)

The parameter u is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The Theis recovery method is a semi-log analysis like the Cooper and Jacob method and has the same restriction on the dimensionless parameter "u" In this method the recovery data are plotted on an arithmetic scale and the time since pumping started, t, divided by the time since pumping stopped, t', are plotted on a logarithmic scale Transmissivity is determined by measuring the slope of a straight line drawn through the data plot over one log cycle Of the three methods, the Theis recovery technique is less sensitive to fluctuations in pumping rate, a weighted mean pumping rate will usually provide adequate results

Well bore storage can influence the interpretations from both the Theis and Jacob methods Papadopulos and Cooper (1967) developed an equation for radial flow to a pumping well in a confined aquifer which takes into account casing storage influences Drawdown values calculated from their equation differ significantly from the Theis and Cooper and Jacob equations during the early portion of the pumping tests when a relatively high percentage of the discharge from a pumping well is derived from casing storage. Schafer (1978) provides the following semi-empirical equation for determining $t_c$, the time in minutes into a test when casing storage effects become negligible

$$t_c = (0.6(d_c^2-d_p^2))/(Q/s)$$

where $d_c$ = inside diameter of well casing in inches
$d_p$ = outside diameter of pump column pipe in inches
Q/s = specific capacity of the well in gpm/ft of drawdown at time, $t_c$

Since $t_c$ must be known or assumed in order to determine the specific capacity Q/s at time $t_c$, an iterative procedure is needed to determine $t_c$ from pumping test results Once the value of $t_c$ is known, the portion of the test that can be interpreted with the Theis (1935) and Cooper and Jacob (1946) methods can be identified Schafer's (1978) analysis was developed for confined aquifer conditions The well bore storage influence may be somewhat less for unconfined conditions depending upon the degree of anisotropy Thus, for the unconfined pump test analysis, Schafer's equation provides a conservative indication of the range of data subject to well bore storage influences in the pumped well

Although well bore storage effects are generally associated only with pumping well results, Black and Kipp (1977) show how well bore storage can also influence the interpretations from observation wells using the Theis solution In this study, well bore storage influences were not considered in the analysis of the observation well response because it would be difficult to distinguish well bore storage influences form delayed yield effects

Variable pumping rates invalidate the use of conventional pump test analysis techniques such as the Cooper and Jacob and Theis methods Birsoy and Summers (1980) have developed a technique for determining aquifer parameters from variable and intermittent pumping data The technique requires that the Theis conditions apply, other than constant discharge In other words, the technique applies to radial flow to a well which behaves like a confined isotropic, homogeneous aquifer The technique can be applied to the adjusted drawdown from an unconfined aquifer response using Jacob's (1963) adjustment described above provided the drawdown is small relative to the aquifer thickness The Birsoy and Summers technique does not account for well bore storage influences Also, the technique involves the Jacob approximation of the Theis equation and thus applies only to the portion of the aquifer tests in which the dimensionless parameter "u" is less than 0 01

For many unconfined aquifer tests, the results may not be amenable to analysis by the Theis or Cooper and Jacob methods Boulton (1963) observed that the drawdowns from unconfined aquifer pump test when plotted against time on logarithmic paper often followed an inflected curve consisting of a steep segment at early times that closely matched the Theis response, a flat segment at intermediate times, and a somewhat steeper segment at later times The intermediate segment suggested the release from storage of an additional water source which Boulton referred to as "delayed yield" Boulton derived a new flow equation assuming that a component of the storage coefficient varies with time

A variety of explanations have been offered to explain the "delayed yield" phenomenon Drainage from the unsaturated zone has been dismissed by theoretical and experimental data which show that the influence is negligible. Work by Neuman (1975) and Streltsova (1972) both showed that delayed yield phenomenon may be caused by a time lag between the early artesian response of the aquifer and the subsequent downward movement of the water table. Bouwer and Rice (1978) have hypothesized that the delayed yield response could be due to delayed air entry during the early drawdown response However, Neuman (1979) has observed that the delayed yield phenomenon has been observed in a variety of site conditions and does not appear to correlate with hydrogeologic conditions which would contribute to delayed air entry

Neuman's (1975) explanation has gained the greatest acceptance Neuman developed type curves from solutions based on linearization These solutions are generally less restrictive than the Cooper and Jacob (1946) and Theis (1935) recovery analysis but still depend on an assumption that the drawdown at the water table remains small in comparison with the initial saturated thickness of the aquifer

Walton (1978) concludes that analysis of unconfined pump test response can provide meaningful results provided vertical components of flow, anisotropy in permeability, decreases in aquifer saturated thickness, well bore storage effects and partial penetration of wells are recognized and taken into account in the analyses All these factors may appreciably affect the time rate of drawdown, particularly during early pumping periods

## B-2 1 SHORT TERM TESTING PROGRAM

Preliminary aquifer testing was conducted at the French Limited site between May 24 and May 26, 1988 The testing was coordinated with the sampling of wells monitoring the upper alluvial zone in the vicinity of the French Limited site The results of these preliminary aquifer tests are included in Attachment 1 of this appendix

Personnel from ERT operated the pumps and performed the purging and sampling of the wells AHA personnel monitored water level declines and rises during the purging stage of sampling in an effort to obtain preliminary quantitative estimates of transmissivity, hydraulic conductivity and storativity of the upper alluvial zone Because the purging operation moved relatively quickly from well to well, it was often not possible to obtain recovery measurements Nevertheless, the objective of the tests was not to obtain accurate estimates of aquifer characteristics, but to obtain preliminary estimates from a large number of sites which would be used in designing more rigorous aquifer tests at a select number of wells

Particular caution was exercised in preventing cross-contamination of the wells To achieve this, the well sounder was washed with deionized water prior to insertion into the well. Water from the purging operation was either pumped directly into the French Lagoon or pumped to temporary holding tanks which were then dumped into the French Limited Lagoon by ERT personnel so as not to risk contamination of soils offsite

Since the pump test measurements were taken when the wells were purged prior to sampling, there was little control over the pumping rate The pumping times were of short duration which usually allowed for only one flow measurement. The only tests with more than one flow measurement, pump tests at ERT-4 and REI-10-3, showed that pumping rates appear to have varied significantly during the test with rates dropping during the later part of the pumping period The variable pumping rates make interpretations based upon one pumping rate measurement suspect Because of the problems with pumping rate control, it appears that the most reliable tests from the short term testing program are the tests that were of short enough duration to be interpreted as slug tests or the wells with specific capacities that were high enough to result in little variation in pumping rate and minimal well bore storage influences

Wells ERT-28 and ERT-30 were pumped for only 4 25 minutes and 2 minutes respectively and were slow to recover Analysis as a slug test was believed to provide valid results, although they still should be viewed as order-of-magnitude estimates Transmissivity values of 52 gpd/ft and 63 gpd/ft were determined from the timelag analysis of the test results from wells ERT-28 and ERT-30 respectively Detailed description of the test and the analyses are provided in Attachment 1

The results from wells ERT-23, ERT-24 and ERT-27 indicate relatively high transmissivities. Because of the high specific capacity for these wells, the well bore storage effects appear to have had minimal influence on the test and would have been negligible beyond two minutes into the drawdown and recovery periods. Furthermore, it is likely that the pumping rate was less variable because of the limited drawdown The pumping period was from eight to nine minutes and the flow measurement was recorded about midway through the pumping period The transmissivities estimated from the drawdown and recovery data are 7133 and 8420 gpd/ft respectively for well ERT-23, 2448 and 2922 gpd/ft respectively for well ERT-24 and 7001 gpd/ft from the recovery data for well ERT-27 These estimates are believed to be representative of the approximate magnitude for transmissivities in the immediate vicinity of these wells

The other results from the preliminary testing program are less reliable because of unknown variable pumping rates and well bore storage effects Data from the recovery periods of the preliminary tests on wells ERT-25 and ERT-26 are considered marginal but are believed to provide order-of-magnitude estimates of transmissivity The transmissivity estimated from these tests are 1550 gpd/ft for well ERT-25 and 1300 gpd/ft for well ERT-26

The results from the preliminary tests at wells REI-10-3, ERT-2, ERT-3, ERT-4, ERT-7, ERT-8, ERT-9, and ERT-29 were not used because well bore storage effects and/or variable pumping rates precluded valid interpretations from these tests In fact, attempts to use the results to design the longer term testing program led to overestimating the desired pumping rates for the designed tests because of the overestimation of transmissivities from these tests In that respect, the preliminary test fell short of its intended purpose The attempt to develop preliminary information on aquifer characteristics during well purging may be appropriate for wells exhibiting very high or very low transmissivities but may be inappropriate for wells with transmissivities between these extremes without considerably more control over pumping rates.

## B-2.2 LONGER TERM PUMP TESTING PROGRAM

In the work plan "Pumping Test Program For Shallow Alluvial Aquifer Zone" (July 28, 1988), five wells were selected for the longer term pump tests Four of the locations were selected to develop aquifer characteristics in the vicinity of where groundwater recovery wells would most likely be located immediately south of the French Limited Lagoon. The fifth well, ERT-29 was selected to characterize the aquifer between the French Limited Lagoon and the Riverdale Subdivision. The test program called for pumping each well for six to eight hours and to measure drawdown and recovery in the pumped well and in any observation wells Two of the tests, ERT-20 and ERT-21, were designed as single well tests.

An update of this work plan dated August 3, 1988 was prepared This update included the provision to monitor control variables during each of the tests The recommended control variables were precipitation, lagoon levels (for the proposed REI-10-3) test and at least one control well for each test. The purpose of the control measurements and in particular the control wells is to be able to identify the extraneous fluctuations associated with evapotranspiration and recharge from precipitation and to remove these fluctuations from the water level response in the observation wells in order to arrive at the response due only to pumping It was known from the extensive measurements taken during the aquitard evaluation tests performed in 1986 by Applied Hydrology Associates (AHA, 1986) that the water level fluctuations in the upper alluvial zone are unaffected by barometric fluctuations Therefore, barometric measurements were not included as a control variable

## B-2 3 LONGER TERM PUMP TESTING RESULTS

A number of modifications to the testing program were also made in the field either in response to the sustainable pumping rates which were gererally lower than anticipated or to address concerns raised by personnel from the U S EPA and Jacobs Engineering concerning test locations Short term step drawdown tests were performed on wells REI-10-2, REI-10-3 and REI-10-4 These tests did not include control measurements A longer term test of well REI-10-3 was not performed. Instead, a seven-hour pump test was conducted on well ERT-10 A seven-hour test was also conducted on well ERT-22 Tests of six to eight hours were performed on wells ERT-7 and ERT-21, as called for in the work plan The tests on wells ERT-20, and ERT-29 were terminated short of six hours because of pump failure on well ERT-20 and drawdown to the pump level at well ERT-29.

A summary of the pump tests conducted during the August longer term upper alluvial aquifer analysis program is provided in Table B-2 A description of the background, procedures and results for each test are provided in Attachment 2 along with the field data and reduced data from the pumping well, the observation wells and the control wells The estimates considered to be most representative for each well tested are summarized in Table B-3

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# TABLE B-2

## SUMMARY OF PUMP TESTING PROGRAM
## FRENCH LIMITED SHALLOW AQUIFER TESTS

| Date | Pumped Well | Observation Wells | Control Wells | Pumping Rate rate (gpm) | Pumping Rate time (mins) | Test Duration (mins) DD | Test Duration (mins) Recov | Maximum Drawdown (ft) |
|---|---|---|---|---|---|---|---|---|
| 8-05-88 | REI-10-4 | REI-10-2 | none | 1 5 | 0- 30 | 30 | | 18 62 |
| | | REI-10-3 | | 0 0 | 30- 90 | | 60 | |
| | | | | 2 5 | 90-116 | 26 | | 30 72 |
| 8-08-88 | REI-10-2 | REI-10-3 | none | 0 83 | 0- 34 | 34 | | 27 4 |
| | | REI-10-4 | | 0 59 | 34-100 | 66 | | 34 01 |
| | | | | 0 0 | 100-265 | | 165 | |
| 8-09-88 | REI-10-3 | REI-10-2 | none | 0 5 | 0- 30 | 30 | | 20 37 |
| | | REI-10-4 | | 1 0 | 30- 42 | 12 | | 25 94 |
| | | ERT-1 | | 0 0 | 42-512 | | 470 | |
| 8-08-88 | ERT-20 | GW-08 | ERT-21 | 2 04 | 0- 78 | 137 | 120 | 8 2 |
| and | | | ERT-7A | 2 5 | 78-115 | | | |
| 8-09-88 | | | ERT-7 | 2 67 | 115-137 | | | |
| | | | REI-6-2 | | | | | |
| 8-09-88 | ERT-7 | ERT-7A | REI-10-4 | 6 67 | 0-495 | 495 | 630 | 27 21 |
| | | ERT-8 | REI-6-2 | | | | | |
| | | ERT-8A | ERT-1 | | | | | |
| 8-10-88 | ERT-21 | GW-03 | ERT-20 | 3 83 | 0-480 | 480 | 720 | 16 09 |
| | | | REI-6-1 | | | | | |
| | | | REI-3-3 | | | | | |
| | | | REI-3-2 | | | | | |
| 8-11-88 | ERT-22 | none | ERT-23 | 4 35 | 0- 60 | 420 | 480 | 27 21 |
| | | | ERT-7A | 2.4 | 60-330 | | | |
| | | | ERT-7 | 2 88 | 330-420 | | | |

023650

TABLE B-2 (continued)

| Date | Pumped Well | Observation Wells | Control Wells | Pumping Rate rate (gpm) | Pumping Rate time (mins) | Test Duration (mins) DD | Test Duration (mins) Recov | Maximum Drawdown (ft) |
|---|---|---|---|---|---|---|---|---|
| 8-12-88 | ERT-29 | ERT-28 | ERT-23 | 0 66 | 0- 60 | 460 | 120 | 19 4 |
| | | ERT-30 | | 1 1 | 60-106 | | | |
| | | | | 0 79 | 108-210 | | | |
| | | | | 1 9 | 210-220 | | | |
| | | | | 1 58 | 220-250 | | | |
| | | | | 4 35 | 250-260 | | | |
| 8-15-88 | ERT-10 | ERT-9 | ERT-1 | 2 05 | 0- 97 | 97 | | 33 46 |
| | | ERT-9A | ERT-1A | 0 84 | 97-317 | 220 | | |
| | | ERT-10A | ERT-8 | 0 64 | 317-430 | 113 | | |
| | | | ERT-8A | | | | | |
| | | | REI-10-4 | | | | | |

023651

TABLE B-3

SUMMARY OF UPPER ALLUVIAL AQUIFER TESTS
AUGUST, 1988
FRENCH LIMITED SITE
CROSBY, TEXAS

| PUMP WELL | OBS WELL | ANALYSIS METHOD | T GPD/FT | K CM/S | S | SATURATED SCREENED INTERVAL |
|---|---|---|---|---|---|---|
| ERT-10 | ERT-9 | Bursoy & Sommers (Recovery) | 754 | 1 $19X10^{-3}$ | 0058 | 30 feet |
| ERT-10 | REI-10-4 | Boulton Del Yld | 145 | 2 $28X10^{-4}$ | 00079 | 30 feet |
| ERT-20 | ERT-20 | Birsoy & Sommers (Recovery) | 695 | 9 $37X10^{-4}$ | | 35 feet |
| ERT-21 | ERT-21 | Theis Recovery | 595 | 8 02X10-4 | | 35 feet |
| ERT-22 | ERT-22 | Brisoy & Sommers (Recovery) | 714 | 8 $42X10^{-4}$ | | 40 feet |
| ERT-7 | ERT-8 | Boulton Del Yld | 1387 | 2 $33X10^{-3}$ | 0041 | 28 feet |
| REI-10-2 | REI-10-4 | Boulton Del Yld | 142 | 4 $78X10^{-4}$ | 0086 | 14 feet |
| REI-10-3 | REI-10-3 | Theis Recovery | 4 | 1 $88X10^{-5}$ | | 10 feet |

The results from wells ERT-9, ERT-20, ERT-21 and ERT-22 all indicate similar values for transmissivity in the range from 595 to 754 gpd/ft Results from the drawdown analyses indicate a broader range for transmissivity but the recovery data are considered to be the most reliable The transmissivity estimate of 1387 gpd/ft calculated in the vicinity of well ERT-7 is somewhat higher but corresponds with the higher well yields from wells ERT-7 and ERT-8 The storage coefficient of 0 0041 determined from the recovery analysis corresponds with the early test, elastic storage coefficient as described by Neuman (1975) It is not representative of the specific yield that would characterize the storage coefficient for a long term test or pumping program

Transmissivity values appear to decrease toward the southwest corner of the French Limited Lagoon west of well ERT-9 The transmissivity calculated from the analysis of the response in well ERT-9 during the pump test of well ERT-10 was 754 gpd/ft The storage coefficient of 0 0058 was relatively close to the estimate from the ERT-7 well test The transmissivity values around wells REI-10-2, REI-10-3 and REI-10-4 is substantially lower as evidenced by the very low values for specific capacity for these wells and the pump test results

All the pumping well data from the step drawdown tests at wells REI-10-2, REI-10-3 and REI-10-4 were subject to significant well bore storage influence The drawdown response at observation wells was relatively minor The best response was in well REI-10-4 during pumping of well REI-10-2 Even though the pumping rate changed during the test, the rate change was less than 30 percent and it occurred relatively early during the test The drawdown response was successfully matched to a Boulton Delayed Yield curve with r/B = 2 0 The resulting transmissivity was 142 gpd/ft which seemed reasonable while the corresponding storage coefficient of 00086 was thought to be reasonable for the early test response for an unconfined aquifer

The Boulton Delayed Yield analysis of the response in well REI-10-4 during the pump test of well ERT-10 indicated a remarkably similar aquifer characteristics with a transmissivity of 145 gpd/ft and a storage coefficient of 00079 The Theis recovery analysis of the pump test at well REI-10-3 produced a much lower estimate of transmissivity of only 4 gpd/ft This low value is thought to be representative of conditions in the immediate vicinity of the well given the very low specific capacity of the well and the lack of a response in well ERT-1 located only 20 feet away However, the results at the observation well REI-10-4 are thought to be more representative of the general conditions in the vicinity of the REI-10 well cluster

A more transmissive zone appears to exist in the vicinity of well ERT-23 This zone is localized as evidenced by the low transmissivity values at wells REI-10-2 and REI-10-4 northeast of the well and at wells ERT-28 and ERT-30 located southwest of the well The estimated transmissivity is approximately 8000 gpd/ft. The high transmissivity may be associated with a channel sand. This more transmissive zone does not appear to extend to the southeast as far as the REI-3-3 well but may extend toward the northwest and west in the direction of well ERT-24 and well ERT-27 The preliminary test results at well ERT-24 suggested a transmissivity for this well of approximately 2500 gpd/ft Likewise, the recovery analysis from well ERT-27 indicate a transmissivity of about 7000 gpd/ft However, the results from well ERT-27 were considered to be less reliable because of possible errors in pumping rate measurement and possible influence of well bore storage.

The slug test analysis of wells ERT-28 and ERT-30 suggest very low values of transmissivity for these wells. These results should be viewed as order-of-magnitude estimates considering the limitations of slug test analyses Furthermore, slug test results are representative of the zone immediately around the well bore which may not be representative of the aquifer especially if the well was not thoroughly developed

029654

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021655

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ATTACHMENT 1

PRELIMINARY PUMP TEST DATA AND INTERPRETATION

French Limited Site,

Crosby, Texas

MAY 24 to MAY 26, 1988

023657

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 26, 1988

PUMPED WELL ERT-4

OBSERVATION WELLS ERT-1, radial distance 15 75 feet

CONTROL WELLS· none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells ERT-1 and ERT-4 precede the aquifer test data which follow Prior to purging the pumped well, ERT-4, the depth to static water level below the top of casing in the observation well, ERT-1, was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder on about one minute intervals during well purging The pump was stopped after 11 17 minutes and two recovery measurements were taken Additional recovery measurements were not taken because the purging operation moved quickly to the next well Two measurements taken with a five-gallon bucket and stop watch showed this pumping rate to vary from 12 8 gpm near the start of the pumping to 3 4 gpm about 5 5 minutes after the start of pumping

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns Water levels in the pumped well were not measured during the test

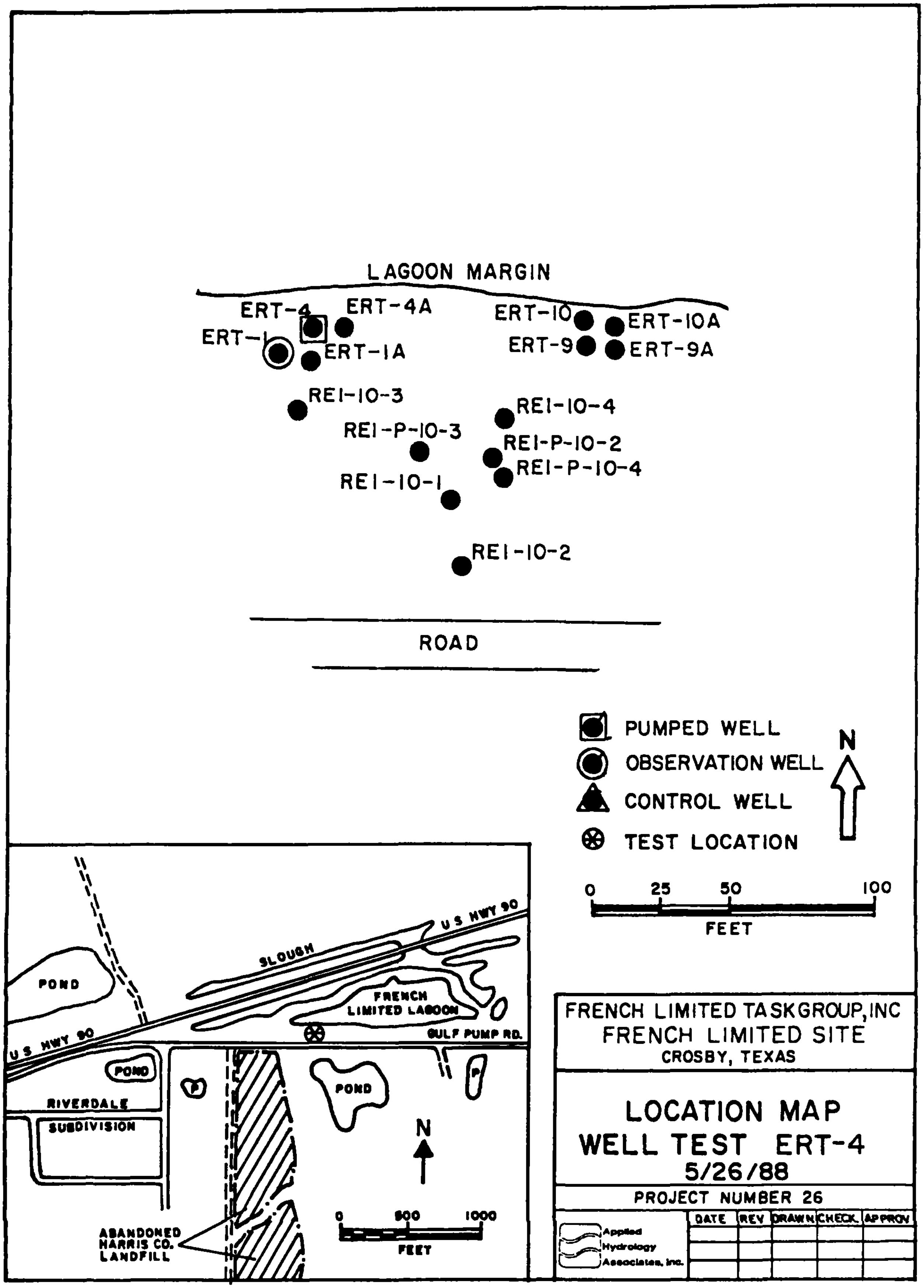
Water produced from the test was dumped directly into the French Limited Lagoon

INTERPRETATION.

The observation well, ERT-1, located 15.75 feet from the pumped well showed a response to pumping that could be matched with a Theis curve using the nonproprietary IGWMC program THCVFIT (van der Heijde, 1987) for aquifer tests in which drawdown data were recorded at an observation well at a distance r from the pumped well The program is based upon the Theis curve matching technique The program allows the user to interactively match a log-log plot of drawdown versus time to a Theis curve The program calculates the match point, the transmissivity and the storage coefficient given the constant pumping rate and the radial distance between the pumped well and the observation well Using the average pumping rate determined from the two measurements, the resulting transmissivity estimate was 3479 gpd/ft , the average hydraulic conductivity was determined to be 5 $5x10^{-3}$ cm/sec, and the storage coefficient was determined to be 014 The results of this analysis are attached

The results of the test are considered questionable because of the variable pumping rate and the lack of recovery measurements which would have been less sensitive to pumping rate fluctuations The u value at the radius of the observation wells was too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers (1980)

023659



LAGOON MARGIN
ERT-4
ERT-4A
ERT-1
ERT-1A
ERT-10
ERT-10A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI-P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 25 50 100
FEET
POND
SLOUGH
U S HWY 90
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
POND
RIVERDALE
SUBDIVISION
POND
N
0 500 1000
FEET
ABANDONED HARRIS CO. LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-4
5/26/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK
APPROV
Applied Hydrology Associates, Inc.

**EKI** 023650

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

# LITHOLOGIC LOG AND CONSTRUCTION OF MW-ERT 4

Sheet 1 of 1

Client French Ltd. Task Group
Project Name Bioremediation
Project Location Crosby, TX
Job No 275-21   MW ERT 4
Logged By SLB
Approved By
Drilled By JS

DRILLING AND SAMPLING INFORMATION
Date Started 3/24/87   Date Completed 3/24/87
Method RW   Total Depth 46 feet

WELL COMPLETION INFORMATION
Screen Dia 4"   Length 27.5 feet
Slot Size 0.010"   Type PVC
Casing Dia 4"   Length 19.5feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0–50 | WELL ADJACENT TO PREVIOUSLY INSTALLED WELL CUTTINGS AND DRILLIND RATE COMPARED WITH PREVIOUS LOG | | | | | | | | |
| | WELL BORE WASHED TO 46 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD CASING INSTALLED, SAND PACKED AND SEALED WITH 1/4" BENTONITE PELLETS, GROUTED TO THE SURFACE WITH CLASS I CEMENT/BENTONITE SLURRY VIA TREMIE PIPE WELL CAPPED, VENTED NOTCHED AND COVERED WITH A CAST IRON STAND-PIPE. | | | | | | | | |

SAMPLER TYPE
S DRIVEN SPLIT SPOON   CC-CONTINUOUS CORNER
T PRESSED SHELBY TUBE   CS CALIFORNIA SAMPLER

BORING METHOD
HSA HOLLOW STEM AUGERS   AR-AIR ROTARY
CFA CONTINUOUS FLIGHT AUGERS   RW-ROTARY WASH

0236E1
**ERI**
A RESOURCE ENGINEERING COMPANY

FIGURE 4-3
# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERI 1

Sheet 1 of 1

Client: French Ltd Task Group
Project Name: Bioremediation
Project Location: Crosby, TX
Job No: 275-21
MW: ERI 1
Logged By: SLB
Approved By:
Drilled By: JS

DRILLING AND SAMPLING INFORMATION
Date Started: 3/11/87
Date Completed: 3/11/87
Method: RW
Total Depth: 50 feet

WELL COMPLETION INFORMATION
Screen Dia: 4"
Length: 30 feet
Slot Size: 0.010"
Type: PVC
Casing Dia: 4"
Length: 20 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE ELEVATION | | | | | | | | |
| 10 | SILTY SAND-gray, medium to fine grain, wet, asorted multicolored fines, odor | | | | | | | | |
| 20 | thin gravel ledge slight odor, dark gray sludge | | | | | | | | |
| 30 | SANDY CLAY-gray, multicolor gravels washing from above | | | | | | | | |
| | SANDY SILT & SILTY SAND-tan, strong odor | | | | | | | | |
| 40 | | | | | | | | | |
| | VERY SILTY CLAY-gray and white, odor | | | | | | | | |
| 50 | | | | | | | | | |

STRATIFICATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE, CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
S DRIVEN SPLIT SPOON
T PRESSED SHELBY TUBE
CC-CONTINUOUS CORNER
CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
AR-AIR ROTARY
RW-ROTARY WASH

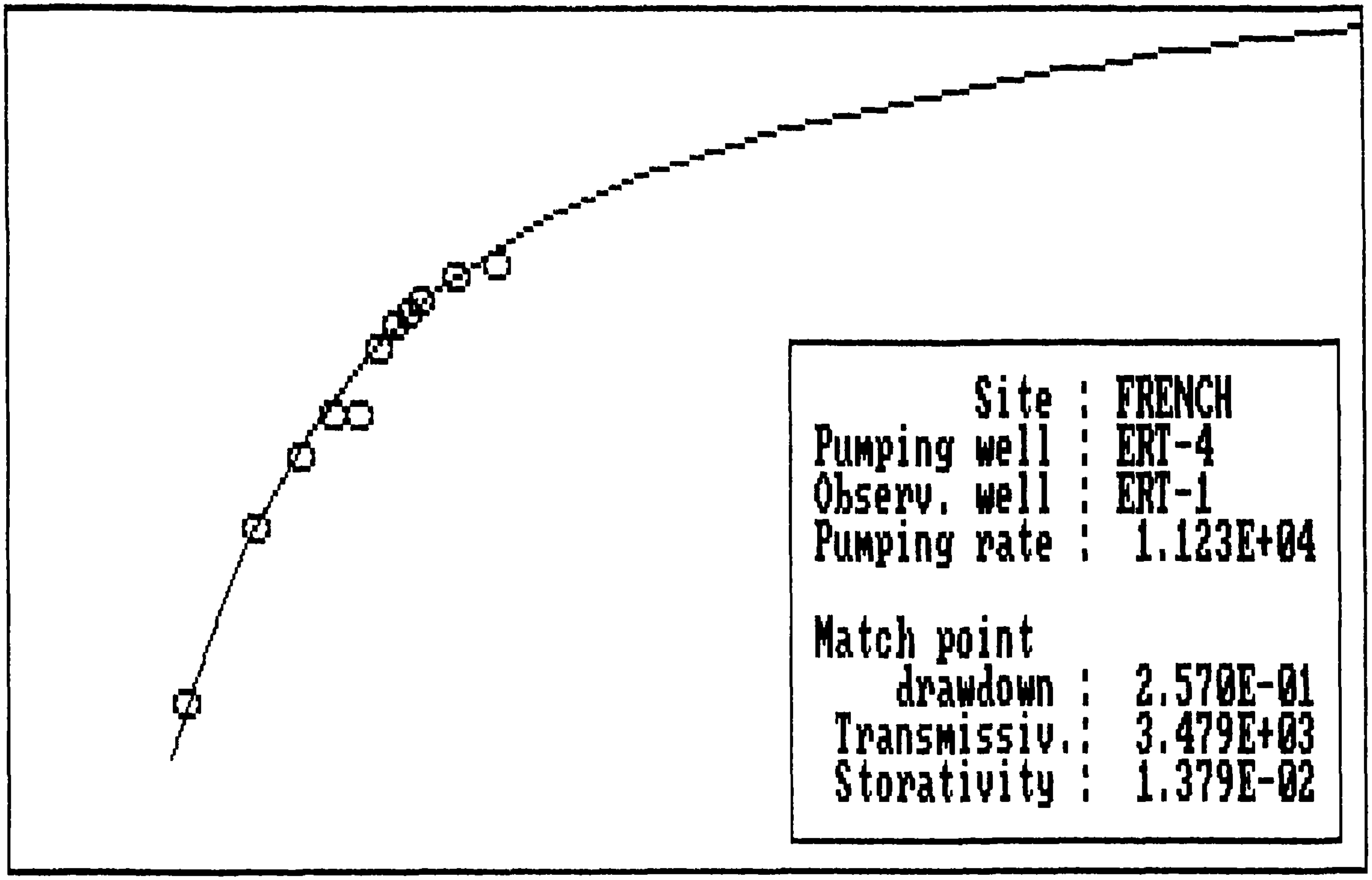
023662

FRENCH LIMITED
CROSBY, TX

ERT-1 OBSERVATION
ERT-4 PUMPED
DATE: 5/26/88
STATIC WATER LEVEL: 6.08 FEET
PUMPING RATE: 7.8 GPM = 11,232 GPD (WEIGHTED MEAN AVERAGE)
DISTANCE TO OBSERVATION POINT: 15.75 FOOT
TOTAL DEPTH OF WELL: 43.38 FEET (SOUNDED)
AQUIFER THICKNESS: 43.38 - 6.08 = 37.30 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 1.20 | | 6.09 | 0.01 | 0.01 | 5 gal/23.4 sec |
| 2.20 | | 6.12 | 0.04 | 0.04 | |
| 3.20 | | 6.15 | 0.07 | 0.07 | |
| 4.20 | | 6.18 | 0.10 | 0.10 | |
| 5.20 | | 6.18 | 0.10 | 0.10 | 5 gal 36 sec |
| 6.20 | | 6.25 | 0.17 | 0.17 | |
| 7.20 | | 6.28 | 0.20 | 0.20 | |
| 8.20 | | 6.30 | 0.22 | 0.22 | |
| 9.20 | | 6.32 | 0.24 | 0.14 | |
| 11.1 | | | | | Pump Off |
| 12.20 | 1.03 | 6.38 | 0.30 | 0.30 | |
| 13.20 | 2.03 | 6.40 | 0.32 | 0.32 | |

Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End

023684



INITIAL DATA:

Site name: FRENCH
Name of pumping well: ERT-4
Name of observation well: ERT-1

Constant pumping rate................Q = 11232 gal/day
Radial distance to observation well...R = 15.75 ft
Matchpoint drawdown..................SA = .2570398 ft
Number of response pairs............NUM = 11

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown ft |
|---|---|---|---|---|---|
| 1 | 1.20 | 0.01 | 2 | 2.20 | 0.04 |
| 3 | 3.20 | 0.07 | 4 | 4.20 | 0.10 |
| 5 | 5.20 | 0.10 | 6 | 6.20 | 0.1[illegible] |
| 7 | 7.20 | 0.20 | 8 | 8.20 | 0.22 |
| 9 | 9.20 | 0.24 | 10 | 10.20 | [illegible] |

CALCULATED PARAMETERS

Transmissivity TRANS = 3.4791E+03gal/day/ft
Storage coefficient STOR = 1.3792E-02

# FRENCH LIMITED SITE
## PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST. May 26, 1988

PUMPED WELL REI-10-3

OBSERVATION WELLS ERT-1, radial distance 20 4 feet

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells REI 10-3 and ERT-1 precede the aquifer test data which follow Prior to purging the well the depth to static water level below the top of casing in both the pumped well and the observation well were measured using an electronic well sounder with accuracy to 01 feet The pumped well, REI 10-3, was purged with a submersible pump and water level measurements were taken with the electric sounder during well purging Recovery measurements were not taken in the observation well, ERT-1, but were recorded in the pumped well The well bore in well REI-10-3 was purged nearly dry after 2 27 minutes of pumping causing the pump to stop several times during the 15 7 minute purging operation One flow measurement of 11 54 gpm was taken via a five-gallon bucket and stop watch during the initial pumping period From the one flow measurement and the on and off times of pumping, a weighted mean pumping rate of 2 29 gpm was estimated Obviously, the pumping rate varied considerably during the purging operation because of starting and stopping of the pump

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns Water levels in the pumped well were also measured during the test

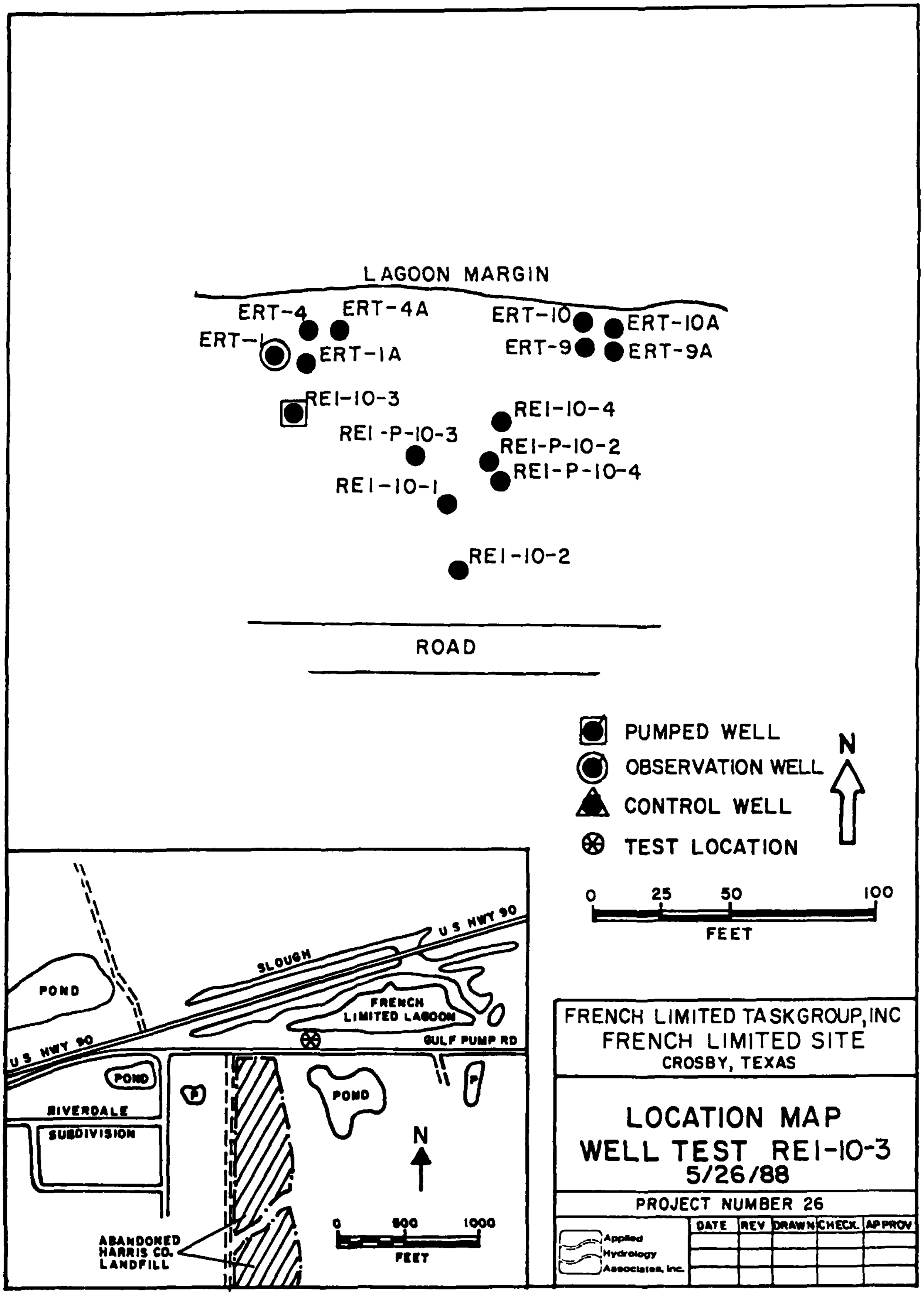
Water produced from the test was dumped directly into the French Limited Lagoon

INTERPRETATION

The observation well ERT-1 located 20 4 feet from the pumped well, REI 10-3, showed a response to pumping that could be matched with a Theis curve using the nonproprietary International Ground Water Modeling Center (IGWMC) program THCVFIT (van der Heijde, 1987) for aquifer tests in which drawdown data were recorded at an observation well at a distance r from the pumped well The program is based upon the Theis curve matching technique The program allows the user to interactively match a log-log plot of drawdown versus time to a Theis curve The program calculates the match point, the transmissivity and the storage coefficient given the constant pumping rate and the radial distance between the pumped well and the observation well Using the weighted mean pumping rate of 2 29 gpm, the resulting transmissivity estimate was 1859 gpd/ft, the average hydraulic conductivity was determined to be 2 $9x10^{-3}$ cm/sec and the storage coefficient was determined to be 0 008

The recovery data from the pumped well were analyzed using the nonproprietary International Ground Water Modeling Center (IGWMC) program RECOVERY in the PUMPTEST package (Beljin, 1986) which is based upon the Theis (1935) recovery method in which residual drawdown is plotted on an arithmetic scale against the parameter t/t' (time since pumping started/time since pumping stopped) on a log scale RECOVERY also allows the user to interactively specify which data are to be fitted to a straignt line Using the weighted mean pumping rate of 2 29 gpm, the resulting transmissivity estimate was 7 gpd/ft and the hydraulic conductivity was 1 $1x10^{-5}$ cm/sec The results of these analyses are attached

The results of the test are considered questionable because of the variable pumping rate and the discrepancy in the magnitude of the transmissivity between the two methods The estimate using the recovery measurements is less sensitive to pumping rate fluctuation but is still determined to be an unreliable estimate because of the variable pumping rate and well bore storage effects in the pumped well



LAGOON MARGIN
ERT-4
ERT-4A
ERT-10
ERT-10A
ERT-1
ERT-1A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI -P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 25 50 100
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE SUBDIVISION
P
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST REI-10-3
5/26/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV
DRAWN
CHECK.
APPROV.

023668

**REI RESOURCE ENGINEERING**
SUBSURFACE EXPLORATION



# LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-3

| | |
|---|---|
| Client | FRENCH LTD. TASK GROUP |
| Project Name | French Ltd. 1986 F.I. |
| Project Location | Crosby, Texas |
| Job No | 275-14 |
| Boring No | 10-3 |
| Logged By | S. ⌞ Baird |
| Approved By | |
| Drilled By | SWI |

**DRILLING AND SAMPLING INFORMATION**

| | | | |
|---|---|---|---|
| Date Started | 7/27/86 | Date Completed | 7/27/86 |
| Method | MR | Total Depth | 48.0 FEET |

**WELL COMPLETION INFORMATION**

| | | | |
|---|---|---|---|
| Screen Dia | 4" | Length | 10 30' |
| Slot Size | 0 010" | Type | PVC |
| Casing Dia | 4" | Length | 39 66 |

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 13 80 | | | | | | | |
| 0 | SURFACE FILL AND GRAVEL | 10 7 | | | | | | |
| | SAND AND GRAVEL | 4 3 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | 2 6 | | | | | | |
| | SILTY SAND | -18 6 | | | | | | |
| 20 | | | | | | | | |
| 30 | SANDY SILT/CLAYEY SILT | -24 ? | | | | | | |
| 40 | SILT SAND/SANDY SILT | -33 ? | | | | | | |
| | FRY SILTY CLAY, reddish brown | -34 2 | 1 | SS | 53 | | | |
| 50 | TD 48 0 BORING (8") DRILLED TO 48' ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1 FOUR INCH MONITOR WELL SET WITH FLUSH VALVE 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0 010" SLOT SCREEN 3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURREY WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED | | | | | | | |

**SAMPLER TYPE**

SS DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

020669

ERT

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

FIGURE 4-3

# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 1

Client: French Ltd Task Group
Project Name: Bioremediation
Project Location: Crosby, TX
Job No: 275-21
MW: ERT 1
Logged By: SLB
Approved By:
Drilled By: JS

DRILLING AND SAMPLING INFORMATION
Date Started: 3/11/87
Date Completed: 3/11/87
Method: RW
Total Depth: 50 feet

WELL COMPLETION INFORMATION
Screen Dia: 4"
Length: 30 feet
Slot Size: 0.010"
Type: PVC
Casing Dia: 4"
Length: 20 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE ELEVATION | | | | | | | | |
| 10 | SILTY SAND-gray, medium to fine grain, wet, assorted multicolored fines, odor | | | | | | | | |
| 20 | thin gravel ledge slight odor, dark gray sludge | | | | | | | | |
| 30 | SANDY CLAY-gray, multicolor gravels washing from above | | | | | | | | |
| | SANDY SILT & SILTY SAND-tan, strong odor | | | | | | | | |
| 40 | | | | | | | | | |
| 50 | VERY SILTY CLAY-gray and white, odor | | | | | | | | |

FORMATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE, CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
S DRIVEN SPLIT SPOON
T PRESSED SHELBY TUBE
CC-CONTINUOUS CORNER
CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA CONTINUOUS FLIGHT AUGERS
AR-AIR ROTARY
RW-ROTARY WASH

023670

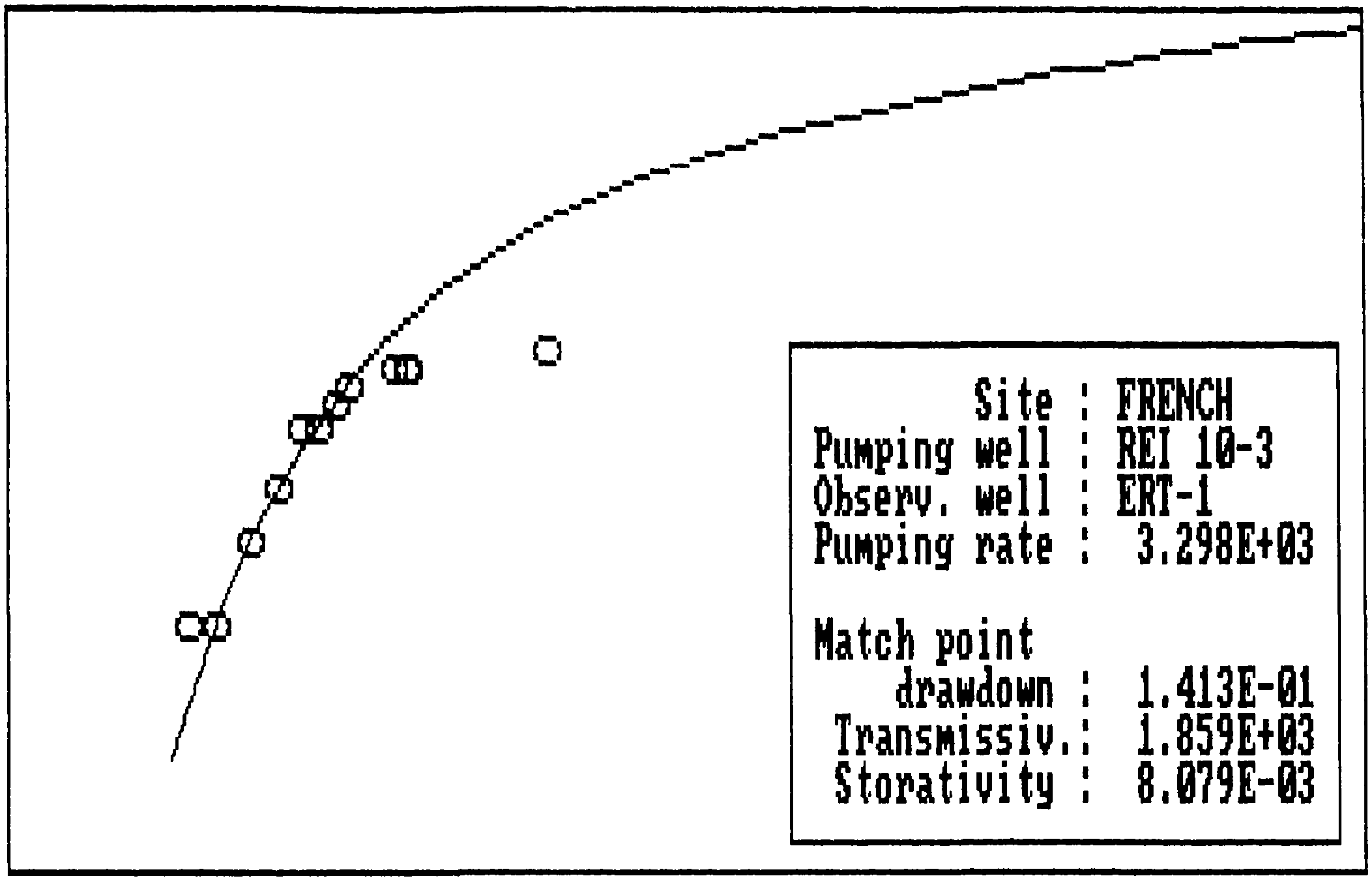
FRENCH LIMITED
CROSBY, TX

ERT-1 OBSERVATION
SET 10-2 PUMPED
DATE: 5/26/88
STATIC WATER LEVEL: 6.05 FEET
PUMPING RATE: 2.29 GPM = 3,397.6 GPD (WEIGHTED MEAN AVERAGE)
DISTANCE TO OBSERVATION POINT: 20.4 FEET
TOTAL DEPTH OF WELL: 43.38 FEET
AQUIFER THICKNESS: 43.38 - 6.05 = 37.33 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| [illegible].27 | | 6.06 | 0.01 | 0.01 | Pump Off |
| [illegible].88 | | 6.06 | 0.01 | 0.01 | |
| [illegible].83 | | 6.07 | 0.02 | 0.02 | |
| 4.38 | | 6.08 | 0.03 | 0.0[illegible] | |
| 5.96 | | 6.10 | 0.05 | 0.05 | |
| [illegible].28 | | 6.10 | 0.05 | 0.05 | |
| [illegible].06 | | 6.11 | 0.06 | 0.06 | |
| [illegible].88 | | 6.12 | 0.07 | 0.07 | |
| 1[illegible] | | 6.13 | 0.08 | 0.08 | |
| 1[illegible].38 | | | | | Pump On |
| [illegible] | | 6.1[illegible] | [illegible] | 0.06 | Pump Off |
| 14.[illegible] | | | | | Pump On |
| 14.[illegible] | | 6.1[illegible] | 0.06 | 0.06 | |
| 15.70 | | | | | Pump Off |
| 48.88 | | 6.12 | 0.09 | 0.09 | |

023671

# Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End

Program THCVFIT Version 1.0 IGWMC Indianapolis - Delft

---

INITIAL DATA:

Site name: FRENCH
Name of pumping well: REI 10-3
Name of observation well: ERT-1

Constant pumping rate.................Q = 3297.6 gal/day
Radial distance to observation well...R = 20.4 ft
Matchpoint drawdown.................SA = .1412539 ft
Number of response pairs...........NUM = 12

---

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown (ft) |
|---|---|---|---|---|---|
| 1 | 2.27 | 0.01 | 2 | 2.36 | 0.01 |
| 3 | 3.66 | 0.02 | 4 | 4.58 | [illegible] |
| 5 | 5.38 | 0.05 | 6 | 5.38 | [illegible] |
| 7 | 7.88 | 0.06 | 8 | [illegible] | [illegible] |
| 9 | 12.88 | 0.08 | 10 | 14.5[illegible] | [illegible] |
| 11 | 14.88 | 0.08 | 12 | 43.36 | [illegible] |

---

CALCULATED PARAMETERS

---

Transmissivity TRANS = 1.8587E+03gal/day/ft
Storage coefficient STOR = 8.0792E-03

---

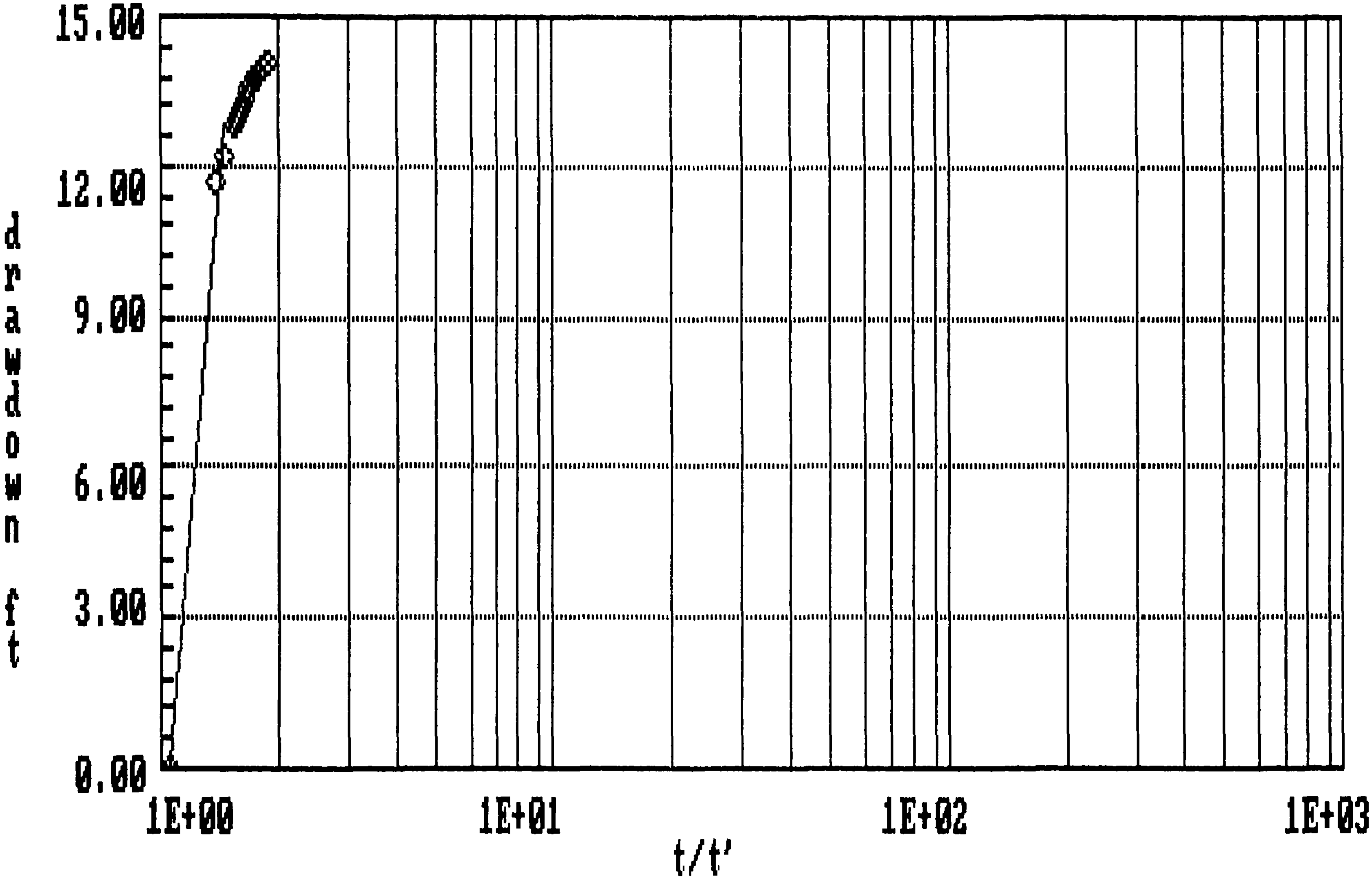
023673

FRENCH LIMITED
CROSBY, TX
WELL REI 10-3

DATE: 5/25/88
STATIC WATER LEVEL: 4.95 FEET
PUMPING RATE: 2.29 GPM (WEIGHTED MEAN)
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 42.25 FEET (SOUNDED)
AQUIFER THICKNESS: 42.25 - 4.95 = 37.30 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s (feet) | Comments |
|---|---|---|---|---|---|
| 2.27 | | | | | Pump Off |
| 1[illegible] | | | | | Pump On (No Water Pumped |
| 14.57 | | | | | Pump Off |
| 14.5[illegible] | | | | | Pump On |
| 15.[illegible] | | | | | Pump Off |
| 33.8[illegible] | 18.15 | 23.60 | 18.65 | 14.0[illegible] |  |
| 34.88 | 19.18 | 23.56 | 18.61 | 13.97 |  |
| 35.88 | 20.18 | 23.30 | 18.35 | 13.[illegible]4 |  |
| 36.88 | 21.18 | 23.06 | 18.11 | 13.71 |  |
| [illegible] | 22.18 | 22.85 | 17.90 | 13.50 |  |
| [illegible] | [illegible].18 | 22.6[illegible] | [illegible] | [illegible] |  |
| [illegible] | 24.18 | 22.40 | 17.45 | 1[illegible] |  |
| 40.88 | 25.18 | 22.18 | 17.23 | 13.25 |  |
| 41.88 | 26.18 | 21.95 | 17.00 | 13.13 |  |
| 42.88 | 27.18 | 21.75 | 16.80 | 13.02 |  |
| 43.88 | 28.18 | 21.58 | 16.63 | 12.92 |  |
| 44.88 | 29.18 | 21.41 | 16.46 | 12.83 |  |
| 50.88 | 35.18 | 20.34 | 15.39 | 12.22 |  |
| 56.88 | 41.18 | 19.39 | 14.44 | 11.64 |  |

REI 10-3




FILE: REI103R.DAT



0236674

023675

```
*****************************************************
*                                                   *
*             program:  Recovery                    *
*             version:  IBM PC 1.0                  *
*                                                   *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S   *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD. *
*                                                   *
*****************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = REI 10-3
DATE............ = 5/26/88

STATIC WATER LEVEL   S.W.L.   =  4.95 [ft]
DISCHARGE RATE............... =  2.29 [gpm]
DURATION OF PUMPING PERIOD... =  15.7 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 18.18 | 33.88 | 1.66 | 14.090 | +.000E+00 |
| 2 | 19.18 | 34.88 | 1.82 | 13.970 | +.000E+00 |
| 3 | 20.18 | 35.88 | 1.78 | 13.940 | +.[illegible]E+0[illegible] |
| 4 | 21.18 | 36.88 | 1.74 | 13.710 | +.[illegible]E+[illegible] |
| 5 | 22.18 | 37.98 | 1.71 | 13.600 | +.000E+00 |
| 6 | 23.18 | 38.88 | 1.68 | 13.490 | +.000E+00 |
| 7 | 24.18 | 39.88 | 1.65 | 13.[illegible]70 | +.000E+00 |
| 8 | 25.18 | 40.88 | 1.62 | 13.250 | -.334E-01 |
| 9 | 26.18 | 41.88 | 1.60 | 13.1[illegible]0 | -.[illegible]E-01 |
| 10 | 27.18 | 42.88 | 1.58 | 13.020 | -.[illegible]E-02 |
| 11 | 28.18 | 43.88 | 1.56 | 12.9[illegible]0 | +.[illegible]E-0[illegible] |
| 12 | 29.18 | 44.88 | 1.54 | 12.[illegible] | -.[illegible]E-0[illegible] |
| 13 | 35.18 | 50.88 | 1.45 | 12.[illegible]20 | -.[illegible]E-0[illegible] |
| 14 | 41.18 | 56.88 | 1.38 | 11.540 | +.[illegible]E+0[illegible] |
| 15 | 314.00 | 329.70 | 1.05 | 0.000 | -.563E-01 |

TRANSMISSIVITY T = .102E-04 [ft2/s]
               T =       7 [gpd/ft]

DATA SEGMENT ANALYZED :
  - starting with data pair  13
  - ending   with data pair  15

DETERMINATION COEFFICENT = .9917112

*****************************************************

023676

# FRENCH LIMITED SITE
# PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 25, 1988

PUMPED WELL ERT-2

OBSERVATION WELLS ERT-5, radial distance 11 5 feet

CONTROL WELLS none

## BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells ERT-2 and ERT-5 precede the aquifer test data which follow Prior to purging the pumped well, ERT-2, the depth to static water level below the top of casing in the observation well, ERT-5, was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about two or three times per minute starting at three minutes until the pump was stopped after 8 67 minutes of well purging Recovery measurements were not taken because the purging operation moved quickly to the next well Because of the short duration of the test, only one flow measurement was taken at the beginning of the test with a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns Water levels in the production well were not measured during the test

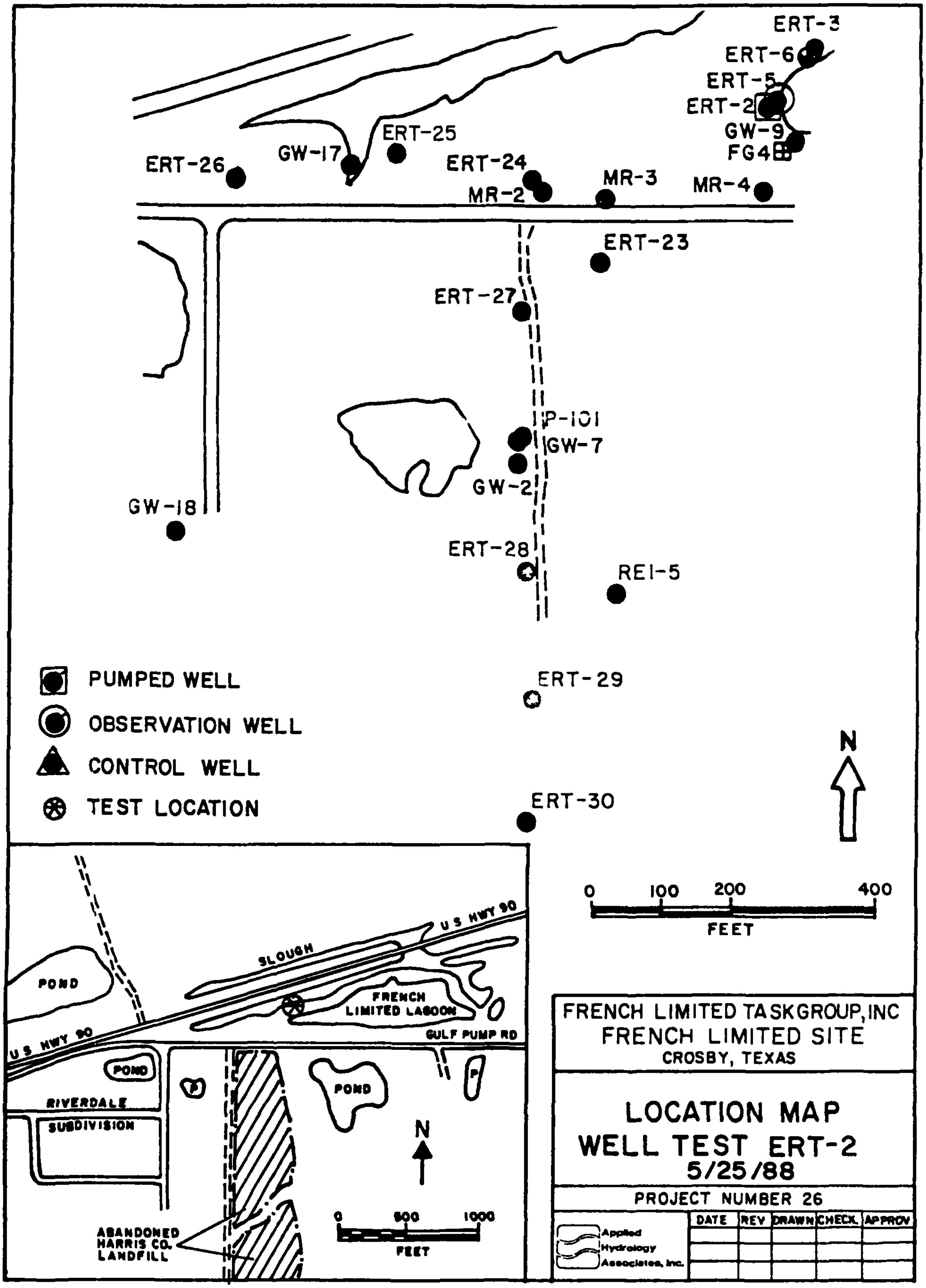
Water produced from the test was dumped directly into the French Limited Lagoon

## INTERPRETATION·

The observation well ERT-5 located 11 5 feet from the pumped well showed a response to pumping that could be matched with a Theis curve using the nonproprietary IGWMC program THCVFIT (van der Heijde, 1987) for aquifer tests in which drawdown data were recorded at an observation well at a distance r from the pumped well. The program is based upon the Theis curve matching technique. The program allows the user to interactively match a log-log plot of drawdown versus time to a Theis curve The program calculates the match point, the transmissivity and the storage coefficient given the constant pumping rate and the radial distance between the pumped well and the observation well Assuming that the pumping rate of 12 3 gpm measured at the beginning of the test is representative of the average pumping rate during the entire test, the resulting transmissivity estimate was 1316 gpd/ft , the average hydraulic conductivity was determined to be 1 $9x10^{-3}$ cm/sec, and the storage coefficient was determined to be 0 011 The results of this analysis are attached

The results of the test are considered questionable because of the likelihood of variable pumping rates and the lack of recovery measurements which would have been less sensitive to pumping rate fluctuations The u parameter value at the radius of the observation wells at the end of pumping was 0 33, which is much too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers

023673


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
ERT-26
GW-17
ERT-24
MR-3
MR-4
MR-2
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
ERT-29
N
ERT-30
0 100 200 400
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
U S HWY 90
POND
RIVERDALE
SUBDIVISION
P
POND
P
N
0 500 1000
FEET
ABANDONED HARRIS CO. LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-2
5/25/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK
APPROV
Applied Hydrology Associates, Inc.

ERT 23679

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

Sheet 1 of 1

# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 2

Client French Ltd Task Group
Project Name Bioremediation
Project Location Crosby, TX
Job No 275-21  MW ERT 2
Logged By SLB
Approved By
Drilled By JS

DRILLING AND SAMPLING INFORMATION
Date Started 3/11/87  Date Completed 3/11/87
Method RW  Total Depth 50 feet

WELL COMPLETION INFORMATION
Screen Dia 4"  Length 32.5 feet
Slot Size 0.010"  Type PVC
Casing Dia 4"  Length 17.5

| DEPTH IN FEET | DESCRIPTION SURFACE ELEVATION | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | ROAD FILL | | | | | | | | |
| 10 | SAND- gray and white slightly silty, medium to fine grained, odor | | | | | | | | |
| | SANDY CLAY-gray | | | | | | | | |
| 20 | | | | | | | | | |
| 30 | SAND-white and gray, very fine to fine grain | | | | | | | | |
| 40 | SLIGHTLY CLAYRY SILT- grayish white, strong odor, wet | | | | | | | | |
| 50 | SILTY CLAY-gray to white, some interbedded sand lenses | | | | | | | | |

FORMATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE, CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS  WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
SS DRIVEN SPLIT SPOON  CC-CONTINUOUS CORNER
T PRESSED SHELBY TUBE  CS-CALIFORNIA SAMPLER

BORING METHOD
HSA HOLLOW STEM AUGERS  AR-AIR ROTARY
CFA CONTINUOUS FLIGHT AUGERS  RW-ROTARY WASH

**ERT** 80

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

Sheet 1 of 1

# LITHOLOGIC LOG AND CONSTRUCTION OF MW-ERT 5

Client: French Ltd. Task Group
Project Name: Bioremediation
Project Location: Crosby, TX
Job No: 275-21 MW: ERT 5
Logged By: SLB
Approved By:
Drilled By: JS

**DRILLING AND SAMPLING INFORMATION**

Date Started: 3/24/87 Date Completed: 3/24/87
Method: RW Total Depth: 50 feet

**WELL COMPLETION INFORMATION**

Screen Dia: 4" Length: 30 feet
Slot Size: 0.010" Type: PVC
Casing Dia: 4" Length: 20 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | |
| 0–50 | WELL ADJACENT TO PREVIOUSLY INSTALLED WELL CUTTINGS AND-DRILLIND RATE COMPARED WITH PREVIOUS LOG. | | | | | | | | |
| 50 | WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD CASING INSTALLED, SAND PACKED AND SEALED WITH 1/4" BENTONITE PELLETS, GROUTED TO THE SURFACE WITH CLASS I CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STAND-PIPE. | | | | | | | | |

SAMPLER TYPE

SS DRIVEN SPLIT SPOON CC-CONTINUOUS CORNER
ST PRESSED SHELBY TUBE CS-CALIFORNIA SAMPLER

BORING METHOD

HSA - HOLLOW STEM AUGERS AR-AIR ROTARY
CFA - CONTINUOUS FLIGHT AUGERS RW-ROTARY WASH

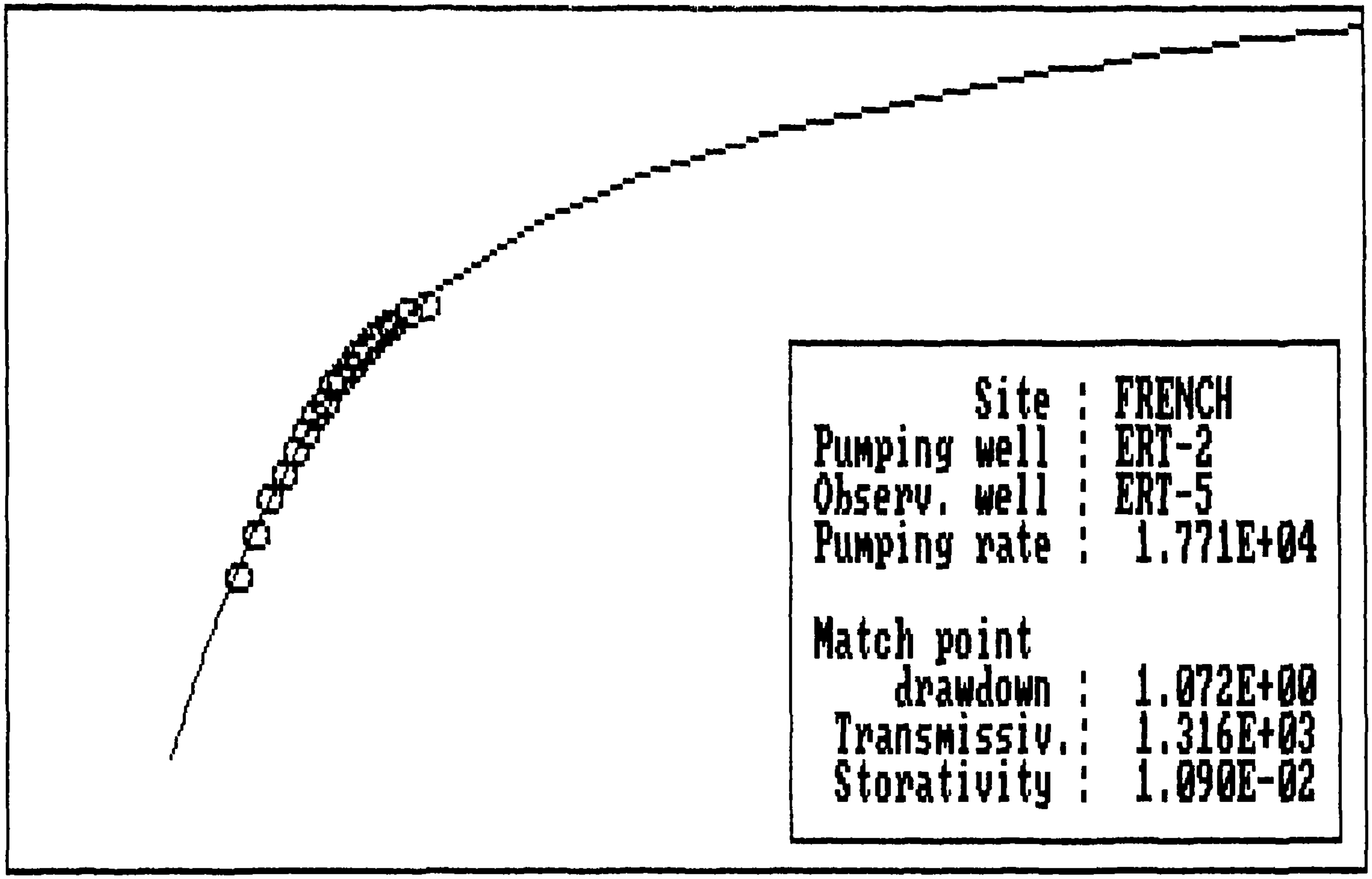
023681

FRENCH LIMITED
CROSBY, TX

ERT-5 OBSERVATION
ERT-2 PUMPED
DATE: 5/25/88
STATIC WATER LEVEL: 6.64 FEET
PUMPING RATE: 12.30 GPM = 17,712 GPD
DISTANCE TO OBSERVATION POINT: 11.50 FEET
TOTAL DEPTH OF WELL: 43.95 FEET
AQUIFER THICKNESS: 43.95 - 6.64 = 37.31 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 1.08 | | 6.75 | 0.11 | 0.11 | 5 gal/24.4 sec |
| [illegible] | | 6.80 | 0.16 | 0.16 | |
| [illegible] | | 6.65 | 0.21 | 0.21 | |
| [illegible] | | 6.90 | 0.26 | 0.26 | |
| [illegible] | | 6.95 | 0.31 | 0.31 | |
| [illegible] | | 7.00 | 0.36 | 0.36 | |
| [illegible] | | 7.05 | 0.41 | 0.41 | |
| 4.48 | | 7.10 | 0.46 | 0.46 | |
| [illegible] | | 7.15 | 0.51 | 0.51 | |
| 5.13 | | 7.20 | 0.56 | 0.56 | |
| [illegible] | | 7.25 | 0.61 | 0.61 | |
| [illegible] | | 7.30 | 0.66 | 0.65 | |
| [illegible] | | 7.35 | 0.71 | 0.70 | |
| [illegible] | | 7.40 | 0.76 | 0.75 | |
| 7.25 | | 7.45 | 0.81 | 0.80 | |
| 7.90 | | 7.50 | 0.86 | 0.85 | |
| 8.67 | | | | | Pump Off |
| 9.08 | 0.42 | 7.60 | 0.96 | 0.95 | |
| 10.50 | 1.83 | 7.64 | 1.00 | 0.99 | |

Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End

Program THCVFIT Version 1.0 IGWMC Indianapolis - Delft

INITIAL DATA:

Site name: FRENCH
Name of pumping well: ERT-2
Name of observation well: ERT-5

Constant pumping rate.................Q = 17712 gal/day
Radial distance to observation well...R = 11.5 ft
Matchpoint drawdown.................SA = 1.071519 ft
Number of response pairs...........NUM = 18

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown(ft) |
|---|---|---|---|---|---|
| 1 | 2.08 | 0.11 | 2 | 2.42 | [illegible] |
| 3 | 2.76 | 0.21 | 4 | 3.15 | [illegible] |
| 5 | 3.47 | 0.31 | 6 | 3.83 | [illegible] |
| 7 | 4.17 | 0.41 | 8 | 4.49 | 0.46 |
| 9 | 4.83 | 0.51 | 10 | 5.13 | 0.56 |
| 11 | 5.57 | 0.61 | 12 | 6.0[illegible] | 0.65 |
| 13 | 6.42 | 0.70 | 14 | 6.85 | 0.75 |
| 15 | 7.25 | 0.80 | 16 | 7.90 | [illegible] |
| 17 | 9.08 | 0.95 | 18 | 10.30 | [illegible] |

CALCULATED PARAMETERS

Transmissivity TRANS = 1.3161E+03gal/day/ft
Storage coefficient STOR = 1.0900E-02

023684

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 25, 1988

PUMPED WELL ERT-3

OBSERVATION WELLS ERT-6, radial distance 10 5 feet

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells ERT-2 and ERT-5 precede the aquifer test data which follow Prior to purging the pumped well, ERT-3, the depth to static water level below the top of casing in the observation well, ERT-6, was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about 3 times per minute starting at 2 22 minutes into the purging operation until pumping was stopped after 5 65 minutes Recovery measurements were taken for an additional four minutes Because of the short duration of the test, only one flow measurements was taken at the beginning of the test with a five-gallon bucket and stop watch which showed the pumping rate to be 12 5 gpm

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns

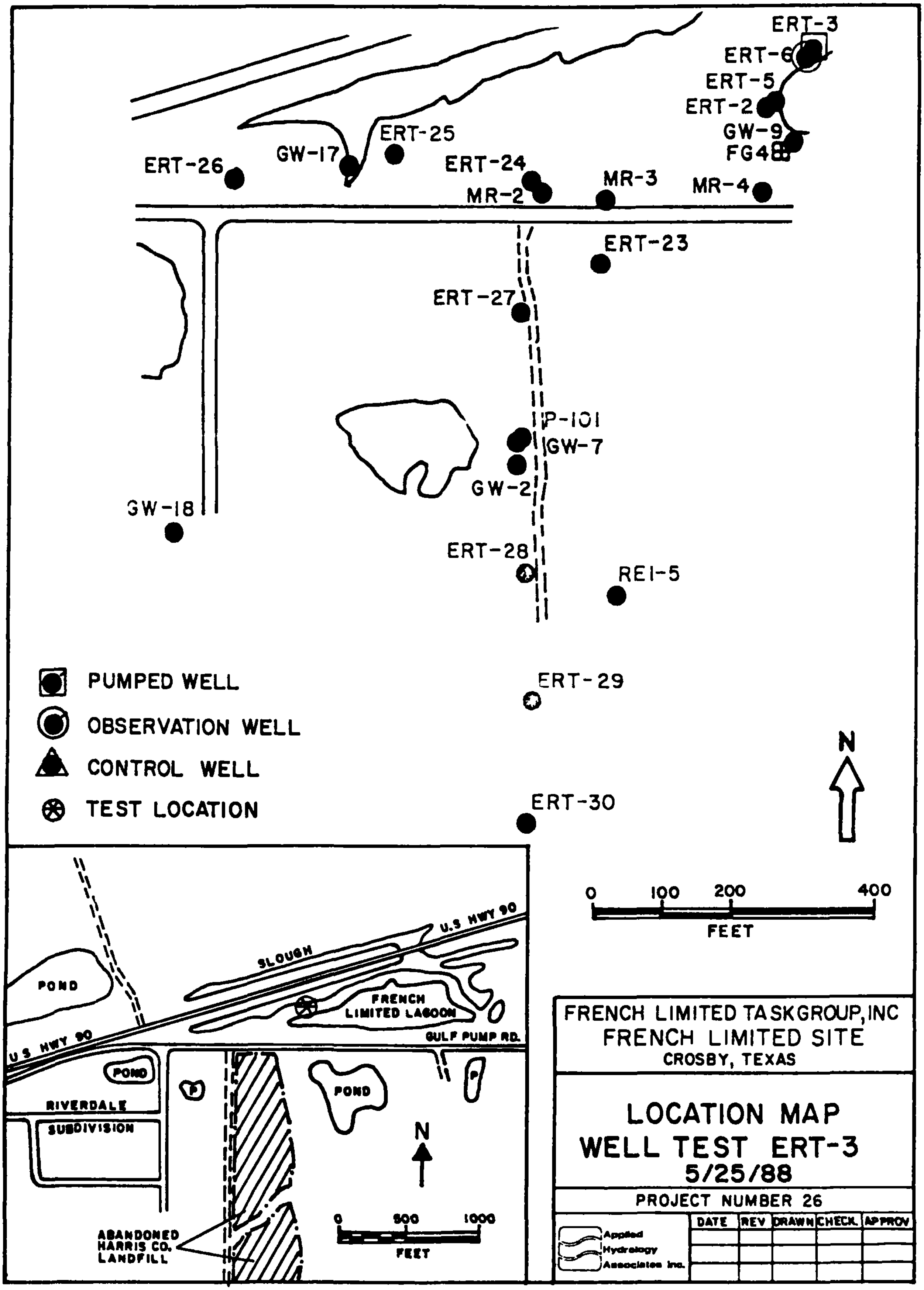
Water produced from the test was dumped directly into the French Limited Lagoon.

INTERPRETATION

The observation well, ERT-6, located 10 5 feet from the pumped well, ERT-3, showed a response to pumping that could be matched with a Theis curve using the nonproprietary IGWMC program THCVFIT (van der Heijde, 1987) for aquifer tests in which drawdown data were recorded at an observation well at a distance r from the pumped well The program is based upon the Theis curve matching technique. The program allows the user to interactively match a log-log plot of drawdown versus time to a Theis curve The program calculates the match point, the transmissivity and the storage coefficient given the constant pumping rate and the radial distance between the pumped well and the observation well Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate was 1015 gpd/ft and the average hydraulic conductivity was determined to be 1 $6\times10^{-3}$ cm/sec and the storage coefficient was determined to be 0 014 The results of this analysis are attached

The results of the test are considered questionable because of the variable pumping rate and the lack of recovery measurements which would have been less sensitive to pumping rate fluctuations The u parameter value at the radius of the observation wells at the end of pumping was 0 72, which is much too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers

023686



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG48
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-4
MR-2
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U.S. HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
U S HWY 90
POND
RIVERDALE SUBDIVISION
P
POND
P
N
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-3
5/25/88
PROJECT NUMBER 26
Applied Hydrology Associates Inc.
DATE REV DRAWN CHECK. APPROV

0ERT

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 3

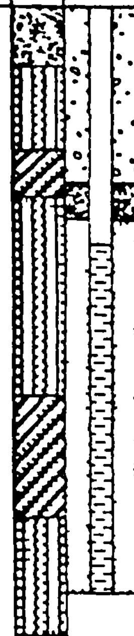


Client French Ltd Task Group
Project Name Bioremediation
Project Location Crosby, TX
Job No 275-21 MW ERT 3
Logged By SLB
Approved By
Drilled By JS

DRILLING AND SAMPLING INFORMATION
Date Started 3/11/87 Date Completed 3/11/87
Method RW Total Depth 48 feet

WELL COMPLETION INFORMATION
Screen Dia 4" Length 28 feet
Slot Size 0.010" Type PVC
Casing Dia 4" Length 20 feet

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | ROAD FILL- black and gray scrap rubber | | | | | | | | |
| | SILTY SAND-gray, medium to fine grained, odor, wet | | | | | | | | |
| 10 | | | | | | | | | |
| | SANDY CLAY-red | | | | | | | | |
| 20 | | | | | | | | | |
| | SILTY SAND-tan, very fine grained wet | | | | | | | | |
| 30 | | | | | | | | | |
| | VERY SANDY CLAY-light gray, interbedded with white very fine sand | | | | | | | | |
| 40 | | | | | | | | | |
| | SILTY SAND-tan, wet, strong odor | | | | | | | | |
| 50 | | | | | | | | | |
| | SANDY CLAY- red, interbedded sand lenses | | | | | | | | |



~~FORMATION CHANGES INTERPRETED BY CHANGES~~ IN DRILLING RATE, CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 48 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
SS DRIVEN SPLIT SPOON CC-CONTINUOUS CORNER
T PRESSED SHELBY TUBE CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS AR AIR ROTARY
CFA - CONTINUOUS FLIGHT AUGERS RW-ROTARY WASH

ERT
A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

Sheet 1 of 1

# LITHOLOGIC LOG AND CONSTRUCTION OF MW-ERT 6

Client: French Ltd. Task Group
Project Name: Bioremediation
Project Location: Crosby, TX
Job No: 275-21 MW: ERT 6
Logged By: SLB
Approved By:
Drilled By: JS

DRILLING AND SAMPLING INFORMATION
Date Started: 3/24/87 Date Completed: 3/24/87
Method: RW Total Depth: 50 feet

WELL COMPLETION INFORMATION
Screen Dia: 4" Length: 30 feet
Slot Size: 0.010" Type: PVC
Casing Dia: 4" Length: 20 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLED INTERVALS HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0–50 | WELL ADJACENT TO PREVIOUSLY INSTALLED WELL CUTTINGS AND-DRILLIND RATE COMPARED WITH PREVIOUS LOG. | | | | | | | | |
| | WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/4" BENTONITE PELLETS, GROUTED TO THE SURFACE WITH CLASS I CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED NOTCHED AND COVERED WITH A CAST IRON STAND-PIPE. | | | | | | | | |

SAMPLER TYPE
S DRIVEN SPLIT SPOON CC-CONTINUOUS CORNER
T PRESSED SHELL TUBE CS-CALIFORNIA SAMPLER

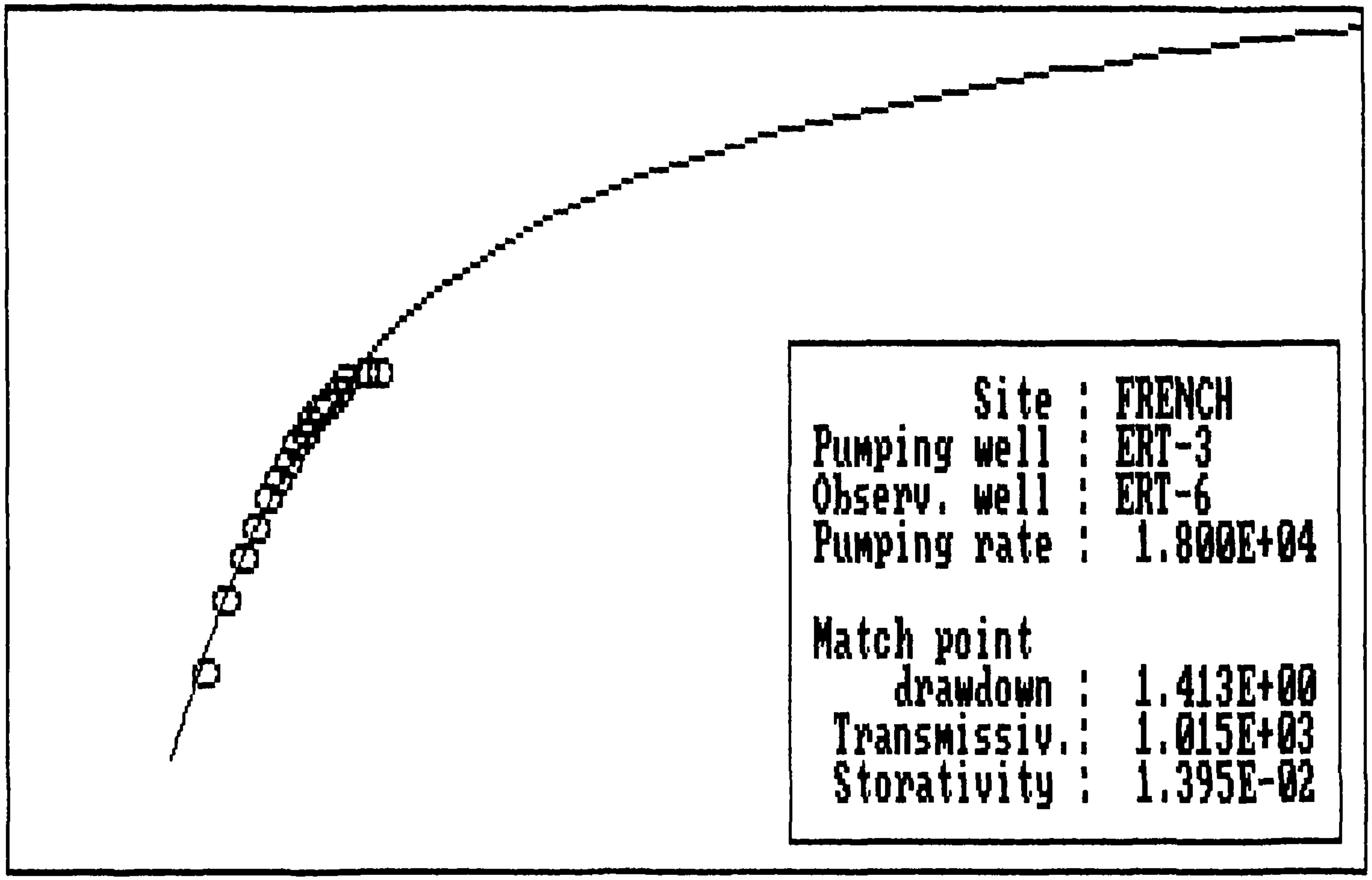
BORING METHOD
HSA HOLLOW STEM AUGERS AR-AIR ROTARY
CFA CONTINUOUS FLIGHT AUGERS RW-ROTARY WASH

FRENCH LIMITED
CROSBY, TX

ERT-6 OBSERVATION
ERT-3 PUMPED
DATE: 5/25/82
STATIC WATER LEVEL: 6.53 FEET
PUMPING RATE: 12.50 GPM = 18,000 GPD
DISTANCE TO OBSERVATION POINT: 10.50 FEET
TOTAL DEPTH OF WELL: 41.65 FEET
AQUIFER THICKNESS: 41.65 - 6.53 = 35.12 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 2.22 | | 6.60 | 0.07 | 0.07 | 5 gal / 24 sec |
| 2.63 | | 6.65 | 0.12 | 0.12 | |
| 3.05 | | 6.70 | 0.17 | 0.17 | |
| 3.38 | | 6.75 | 0.22 | 0.22 | |
| [illegible] | | 6.80 | 0.27 | 0.27 | |
| 4.05 | | 6.85 | 0.32 | 0.32 | |
| 4.42 | | 6.90 | 0.37 | 0.37 | |
| 4.72 | | 6.95 | 0.42 | 0.42 | |
| 5.13 | | 7.00 | 0.47 | 0.47 | |
| 5.42 | | 7.05 | 0.52 | 0.52 | |
| 5.[illegible] | | | | | Pump Off |
| [illegible] | 0.[illegible] | 7.10 | 0.57 | 0.57 | |
| 6.27 | 0.62 | 7.15 | 0.62 | 0.61 | |
| 6.75 | 1.10 | 7.20 | 0.67 | 0.66 | |
| 7.32 | 1.67 | 7.25 | 0.72 | 0.71 | |
| 8.55 | 2.90 | 7.30 | 0.77 | 0.76 | |
| 9.80 | 4.15 | 7.30 | 0.77 | 0.76 | |

Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End



023690

023631

Program THCVFIT Version 1.0 IGWMC Indianapolis - Delft

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INITIAL DATA:

Site name: FRENCH
Name of pumping well: ERT-3
Name of observation well: ERT-6

Constant pumping rate..................Q = 18000 gal/day
Radial distance to observation well...R = 10.5 ft
Matchpoint drawdown...................SA = 1.412578 ft
Number of response pairs............NUM = 16

---

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown(ft) |
|---|---|---|---|---|---|
| 1 | 2.22 | 0.07 | 2 | 2.6[illegible] | 0.12 |
| 3 | 3.05 | 0.17 | 4 | 3.38 | 0.22 |
| 5 | 3.73 | 0.27 | 6 | 4.05 | 0.32 |
| 7 | 4.43 | 0.37 | 8 | 4.7[illegible] | 0.42 |
| 9 | 5.13 | 0.47 | 10 | 5.4[illegible] | 0.52 |
| 11 | 5.87 | 0.57 | 12 | 6.[illegible]7 | 0.61 |
| 13 | 6.75 | 0.66 | 14 | 7.32 | 0.71 |
| 15 | 8.55 | 0.76 | 16 | 9.60 | 0.7[illegible] |

CALCULATED PARAMETERS

---

Transmissivity TRANS = 1.0146E+03gal/day/ft
Storage coefficient STOR = 1.3946E-02

---

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 24, 1988

PUMPED WELL ERT-7

OBSERVATION WELLS ERT-7

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-7 precede the aquifer test data which follow Prior to purging well ERT-7, the depth to static water level below the top of casing was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about three times per minute starting at 2 67 minutes into the test until pumping was stopped after 9 63 minutes Recovery measurements were taken for almost 90 minutes following the test Because of the short duration of the test, only one flow measurements was taken at the beginning of the test with a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was dumped directly into the French Limited Lagoon

INTERPRETATION

The adjusted drawdown data from the pumped well were analyzed using the nonproprietary pump test program JACOBFIT (Beljin, 1f986) available from the International Ground Water Modeling Center The program is based on the Cooper and Jacob (1946) approximation of the Theis equation The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where $r$ is the radial distance between the pumped well and observation well (feet),
$S$ is the storage coefficient (unitless)
$T$ is the transmissivity ($ft^2$/day), and
$t$ is the time since pumping started (days)

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line A second program, RECOVERY (Beljin, 1987), based upon the Theis (1935) recovery method was used to analyze the recovery data

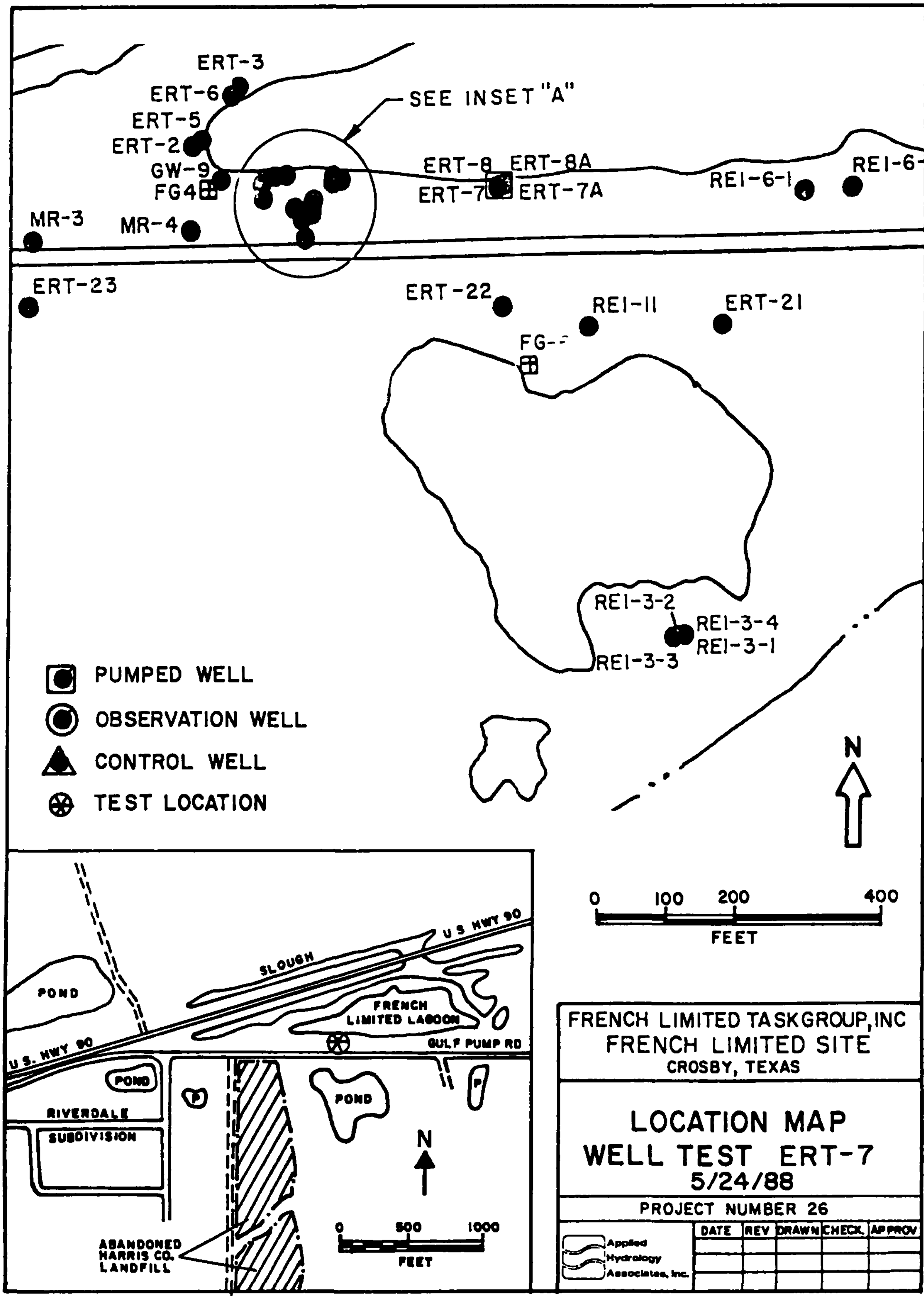
Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate was 963 gpd/ft. using the drawdown data and 1878 gpd/ft using the recovery data The average hydraulic conductivity was determined to be $1\ 6\times10^{-3}$ cm/sec and $3\ 2\times10^{-3}$ cm/sec respectively for the drawdown and recovery results The storage coefficient could not be determined from the single well test The results of these analyses are attached

The results of the test are considered questionable because of the variable pumping rate However the estimates using the recovery data are thought to be more reliable because the recovery response is less sensitive to pumping rate fluctuations Furthermore, well bore storage effects were significant for nearly the entire pumping interval of 9 63 minutes The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2 1 above and shown below

$t_c = 0\ 6(16-1)/(12\ 61/12\ 26^*) = 8\ 75$ minutes

* drawdown at 8 8 minutes into the test

Consequently, the drawdown data for the first 8 8 minutes should not be used for interpretation Likewise, the first 8 8 minutes of the recovery data should not be used If the pumping rate declined during purging from the initial measured value as expected, then the actual transmissivity is probably somewhat lower than the value of 1878 gpd/ft calculated from the recovery results.




FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS

LOCATION MAP
WELL TEST ERT-7
5/24/88

PROJECT NUMBER 26

| Applied Hydrology Associates, Inc. | DATE | REV | DRAWN | CHECK. | APPROV |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

023635

**ERT.**

A RESOURCE ENGINEERING COMPANY



## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-7

Client French LTD
Project Name French LTD
Project Location Crosby Texas
Job Number 275-21 Boring No ERT-7
Logged By D Morgan
Approved By G Spradley
Drilled By Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started 9/28/87 Date Completed 9/28/87
Method MR Total Depth 48

WELL COMPLETION INFORMATION
Screen Dia 4" Length 28 0'
Slot Size 010 Type PVC
Casing Dia 4" Length 17 7'

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLE NO | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fill, roadbase, gravel, sand, silt | | | | | | | | | |
| | Silty Sand, tan to brown/ gray, fine to medium grained some black sludge material | 1 | ST | 80 | - | | | | | |
| 5 | | 2 | SS | 50 | 04 | | | | | |
| | | 3 | SS | 50 | 02 | | | | | |
| | | 4 | SS | 45 | 02 | | | | | |
| 10 | | 5 | SS | 25 | 02 | | | | | |
| | | 6 | SS | 50 | 06 | | | | | |
| 15 | | 7 | SS | 50 | 09 | | | | | |
| | Sand fine to medium grained, gray, strong odor | 8 | SS | 13 | 0.4 | | | | | |
| | | 9 | SS | NR | | | | | | |
| 20 | | 10 | SS | 17 | - | | | | | |
| | | 11 | SS | 45 | - | | | | | |
| 25 | | 12 | SS | 25 | - | | | | | |
| | | 13 | SS | 25 | - | | | | | |
| | Silty Clay gray with some red/brown mottles stiff with some fine grained sand seams some odor | 14 | SS | 50 | - | | | | | |
| 30 | | 15 | ST | 75 | - | | | | | |
| | | 16 | ST | 50 | - | | | | | |
| 35 | Clayey Silt, light gray, soft, saturated some odor | 17 | ST | 75 | - | | | | | |
| | | 19 | ST | NR | | | | | | |
| | | 20 | ST | 75 | - | | | | | |
| 40 | | 21 | SS | 50 | - | | | | | |
| | | 22 | SS | 65 | - | | | | | |
| 45 | | 23 | ST | 50 | - | | | | | |
| | Silty Clay, light gray, stiff, some tan mottles, no odor | 24 | ST | 84 | - | | | | | |
| 50 | BORING TERMINATED AT 480' | | | | | | | | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE

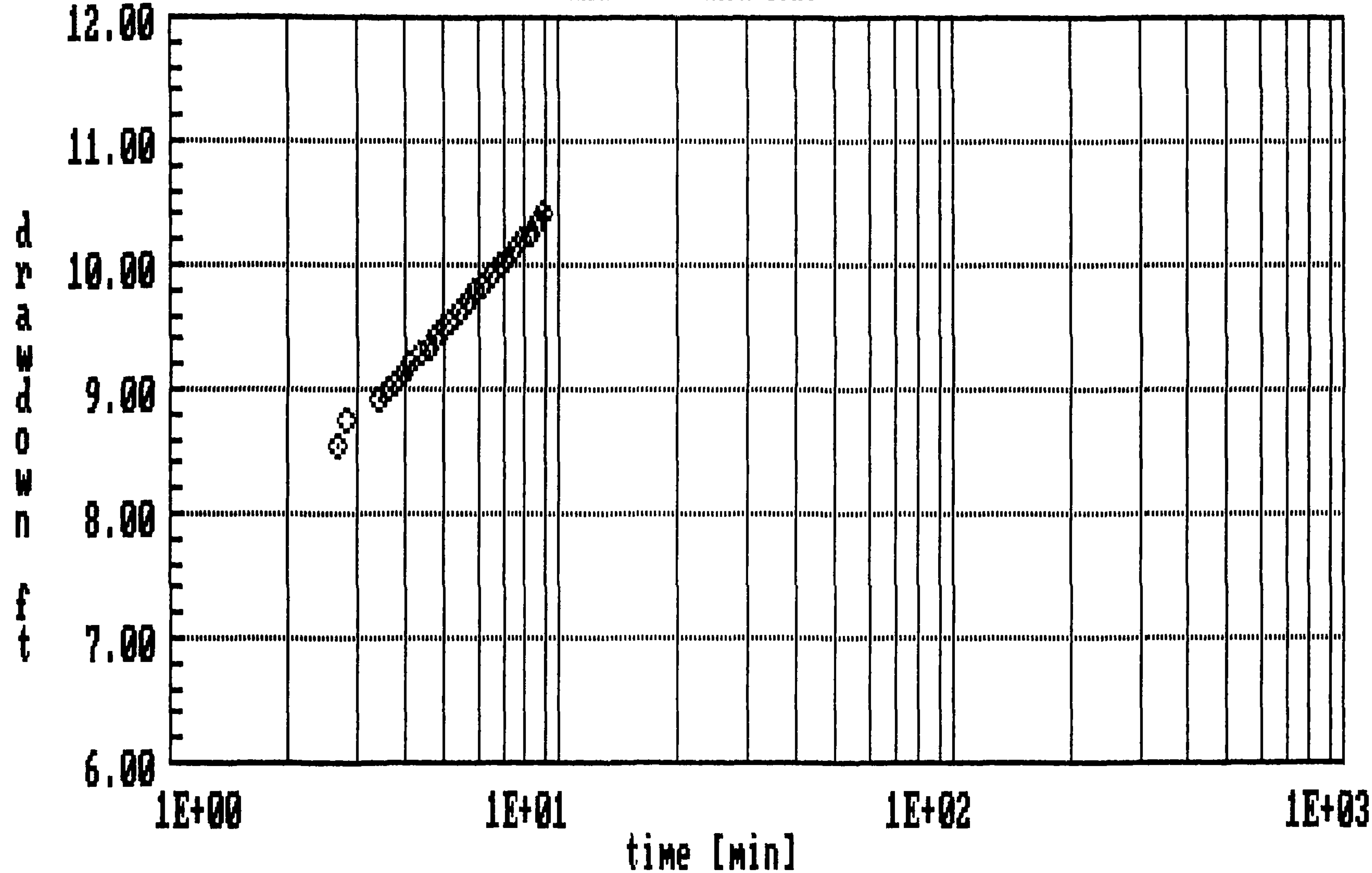
BORING METHOD
HSA - HOLLOW STEM AUGER
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

FRENCH LIMITED
CROSBY, TX
WELL ERT-7

DATE: 5/24/88
STATIC WATER LEVEL: 4.24 FEET
PUMPING RATE: 12.61 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 43.25 FEET (SOUNDED)
AQUIFER THICKNESS: 43.25 - 4.24 = 39.01 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 2.67 | | 14.00 | 9.76 | 8.54 | 5 gal/13.8 sec |
| 2.83 | | 14.30 | 10.06 | 8.76 | |
| 3.42 | | 14.50 | 10.26 | 8.91 | |
| 3.58 | | 14.60 | 10.36 | 8.98 | |
| 3.75 | | 14.70 | 10.46 | 9.06 | |
| 3.92 | | 14.80 | 10.56 | 9.13 | |
| 4.10 | | 14.90 | 10.66 | 9.20 | |
| 4.35 | | 15.00 | 10.76 | 9.28 | |
| 4.57 | | 15.10 | 10.86 | 9.35 | |
| 4.75 | | 15.20 | 10.96 | 9.42 | |
| 5.00 | | 15.30 | 11.06 | 9.49 | |
| 5.20 | | 15.40 | 11.16 | 9.56 | |
| 5.48 | | 15.50 | 11.26 | 9.63 | |
| 5.75 | | 15.60 | 11.36 | 9.71 | |
| 6.03 | | 15.70 | 11.46 | 9.78 | |
| 6.33 | | 15.80 | 11.56 | 9.85 | |
| 6.60 | | 15.90 | 11.66 | 9.92 | |
| 6.95 | | 16.00 | 11.76 | 9.99 | |
| 7.25 | | 16.10 | 11.86 | 10.06 | |
| 7.67 | | 16.20 | 11.96 | 10.13 | |
| 8.05 | | 16.30 | 12.06 | 10.20 | |
| 8.45 | | 16.40 | 12.16 | 10.26 | |
| 8.80 | | 16.50 | 12.26 | 10.33 | |
| 9.15 | | 16.60 | 12.36 | 10.40 | |
| 9.63 | | | | | Pump Off |
| 11.82 | 2.18 | 6.40 | 2.16 | 2.10 | |
| 12.20 | 2.57 | 6.00 | 1.76 | 1.72 | |
| 12.45 | 2.82 | 5.80 | 1.56 | 1.53 | |
| 12.97 | 3.33 | 5.50 | 1.26 | 1.24 | |
| 14.37 | 4.73 | 5.10 | 0.86 | 0.85 | |
| 14.98 | 5.35 | 5.00 | 0.76 | 0.75 | |
| 15.83 | 6.20 | 4.90 | 0.66 | 0.65 | |
| 17.00 | 7.37 | 4.80 | 0.56 | 0.56 | |
| 18.67 | 9.03 | 4.70 | 0.46 | 0.46 | |
| 21.10 | 11.47 | 4.65 | 0.41 | 0.41 | |
| 96.25 | 86.62 | 4.26 | 0.02 | 0.02 | |

ERT-7 DRAWDOWN




FILE: ERT7D.DAT



0236?7

```
*****************************************************
*                                                   *
*             program:  JacobFit                    *
*             version:  IBM PC 1.0                  *
*                                                   *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S   *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD. *
*                                                   *
*****************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-7
DATE............ = 5/25/88

STATIC WATER LEVEL   S.W.L.   =  4.24 [ft]
DISCHARGE RATE............... =  12.61 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]

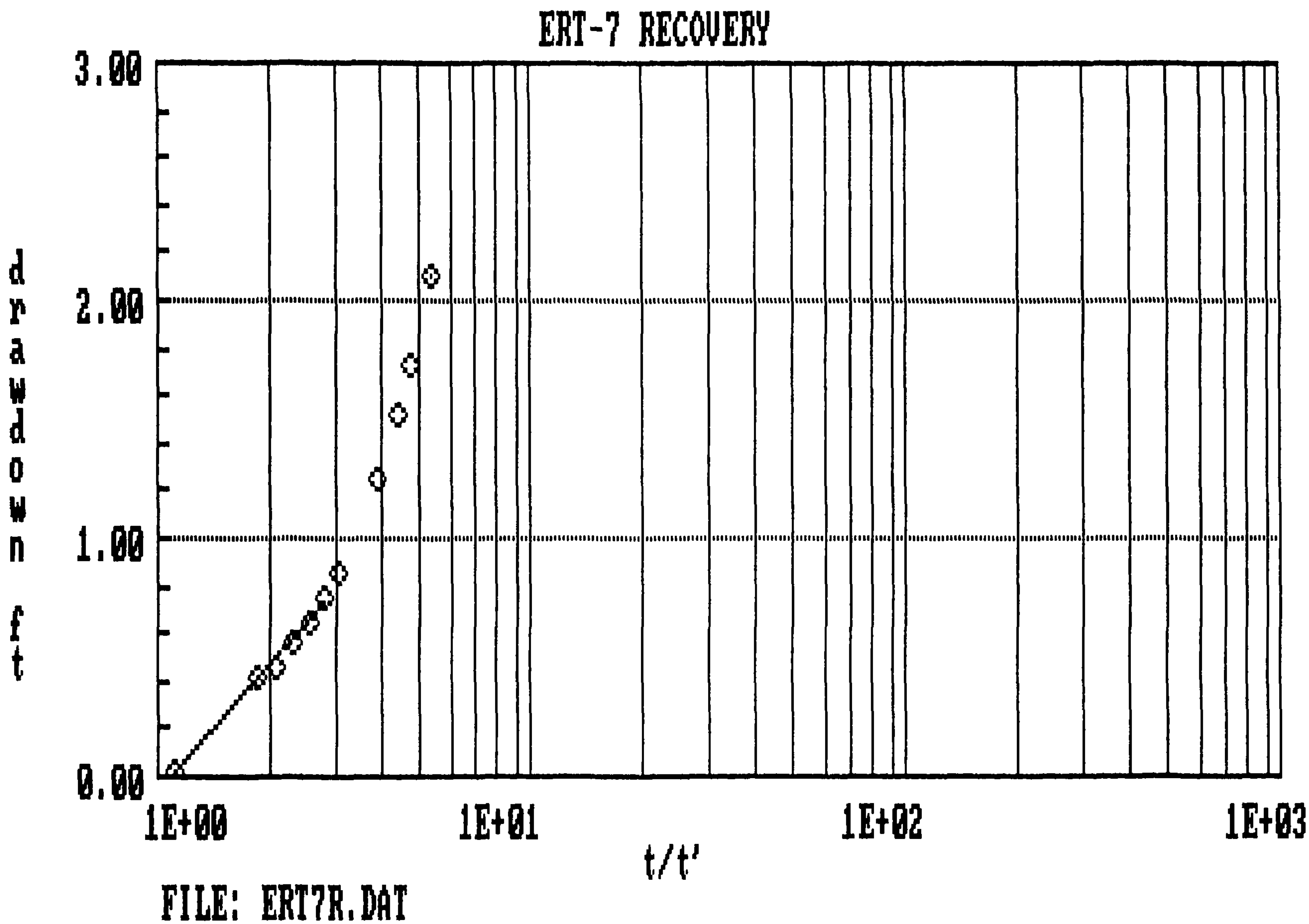
| NO | TIME [min] | DRAWDOWN [ft] | u | DEVIATION |
|---|---|---|---|---|
| 1 | 2.67 | 8.540 | .000E+00 | +.000E+00 |
| 2 | 2.83 | 8.760 | .000E+00 | +.000E+00 |
| 3 | 3.42 | 8.910 | .147E-02 | -.119E-01 |
| 4 | 3.58 | 8.980 | .140E-02 | -.105E-01 |
| 5 | 3.75 | 9.060 | .134E-02 | -.858E-04 |
| 6 | 3.92 | 9.130 | .128E-02 | +.339E-02 |
| 7 | 4.10 | 9.200 | .123E-02 | +.603E-02 |
| 8 | 4.35 | 9.280 | .115E-02 | -.279E-02 |
| 9 | 4.57 | 9.350 | .110E-02 | -.681E-02 |
| 10 | 4.75 | 9.420 | .106E-02 | +.522E-02 |
| 11 | 5.00 | 9.490 | .100E-02 | -.174E-02 |
| 12 | 5.20 | 9.560 | .966E-03 | +.941E-02 |
| 13 | 5.48 | 9.630 | .917E-03 | +.713E-03 |
| 14 | 5.75 | 9.710 | .874E-03 | +.855E-02 |
| 15 | 6.03 | 9.780 | .833E-03 | +.721E-02 |
| 16 | 6.33 | 9.850 | .794E-03 | +.435E-02 |
| 17 | 6.60 | 9.920 | .761E-03 | +.117E-01 |
| 18 | 6.95 | 9.990 | .723E-03 | +.415E-02 |
| 19 | 7.25 | 10.060 | .693E-03 | +.107E-01 |
| 20 | 7.67 | 10.130 | .655E-03 | -.376E-02 |
| 21 | 8.05 | 10.200 | .624E-03 | -.632E-02 |
| 22 | 8.45 | 10.260 | .594E-03 | -.191E-01 |
| 23 | 8.80 | 10.330 | .571E-03 | -.998E-02 |
| 24 | 9.15 | 10.400 | .549E-03 | +.150E-02 |

TRANSMISSIVITY T = .149E-02 [ft2/s]
               T =     963 [gpd/ft]
STORATIVITY    S = .180E-02

DATA SEGMENT ANALYZED :
- starting with data pair  3
- ending   with data pair  24

DETERMINATION COEFFICENT = .9996088

*****************************************************


ERT-7 RECOVERY
drawdown ft
3.00
2.00
1.00
0.00
1E+00
1E+01
1E+02
1E+03
t/t'
FILE: ERT7R.DAT



023699

023700

```
*******************************************************
*                                                     *
*           program:  Recovery                        *
*           version:  IBM PC 1.0                      *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-7
DATE............ = 5/25/88

STATIC WATER LEVEL   S.W.L.   =  4.24 [ft]
DISCHARGE RATE................ =  12.61 [gpm]
DURATION OF PUMPING PERIOD... =  9.63 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 2.18 | 11.81 | 5.42 | 2.100 | +.000E+00 |
| 2 | 2.57 | 12.20 | 4.75 | 1.720 | +.000E+00 |
| 3 | 2.82 | 12.45 | 4.41 | 1.530 | +.000E+00 |
| 4 | 3.33 | 12.96 | 3.89 | 1.240 | +.000E+00 |
| 5 | 4.73 | 14.36 | 3.04 | 0.850 | +.442E-01 |
| 6 | 5.35 | 14.98 | 2.80 | 0.750 | +.269E-01 |
| 7 | 6.20 | 15.83 | 2.55 | 0.650 | -.206E-02 |
| 8 | 7.37 | 17.00 | 2.31 | 0.560 | -.139E-01 |
| 9 | 9.03 | 18.66 | 2.07 | 0.460 | -.293E-01 |
| 10 | 11.47 | 21.10 | 1.84 | 0.410 | +.102E-01 |
| 11 | 86.62 | 96.25 | 1.11 | 0.020 | +.812E-02 |

TRANSMISSIVITY T = .291E-02 [ft2/s]
               T =    1878 [gpd/ft]

DATA SEGMENT ANALYZED :
  - starting with data pair  6
  - ending   with data pair  11

DETERMINATION COEFFICENT = .9939948

*******************************************************

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST· May 26, 1988

PUMPED WELL ERT-8

OBSERVATION WELLS ERT-7, radial distance 8 95 feet

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells ERT-8 and ERT-7 precede the aquifer test data which follow Prior to purging well ERT-8, the depth to static water level below the top of casing in observation well, ERT-7, was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder one to three times per minute starting at 3 33 minutes into the purging operation until pumping was stopped after 9 6 minutes Recovery measurements were taken for an additional four minutes Because of the short duration of the test, only one flow measurement was taken near the beginning of the test using a five-gallon bucket and stop watch which showed the pumping rate to be 12 66 gpm

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns Water levels in the pumped well were not measured during this test

Water produced from the test was dumped directly into the French Limited Lagoon

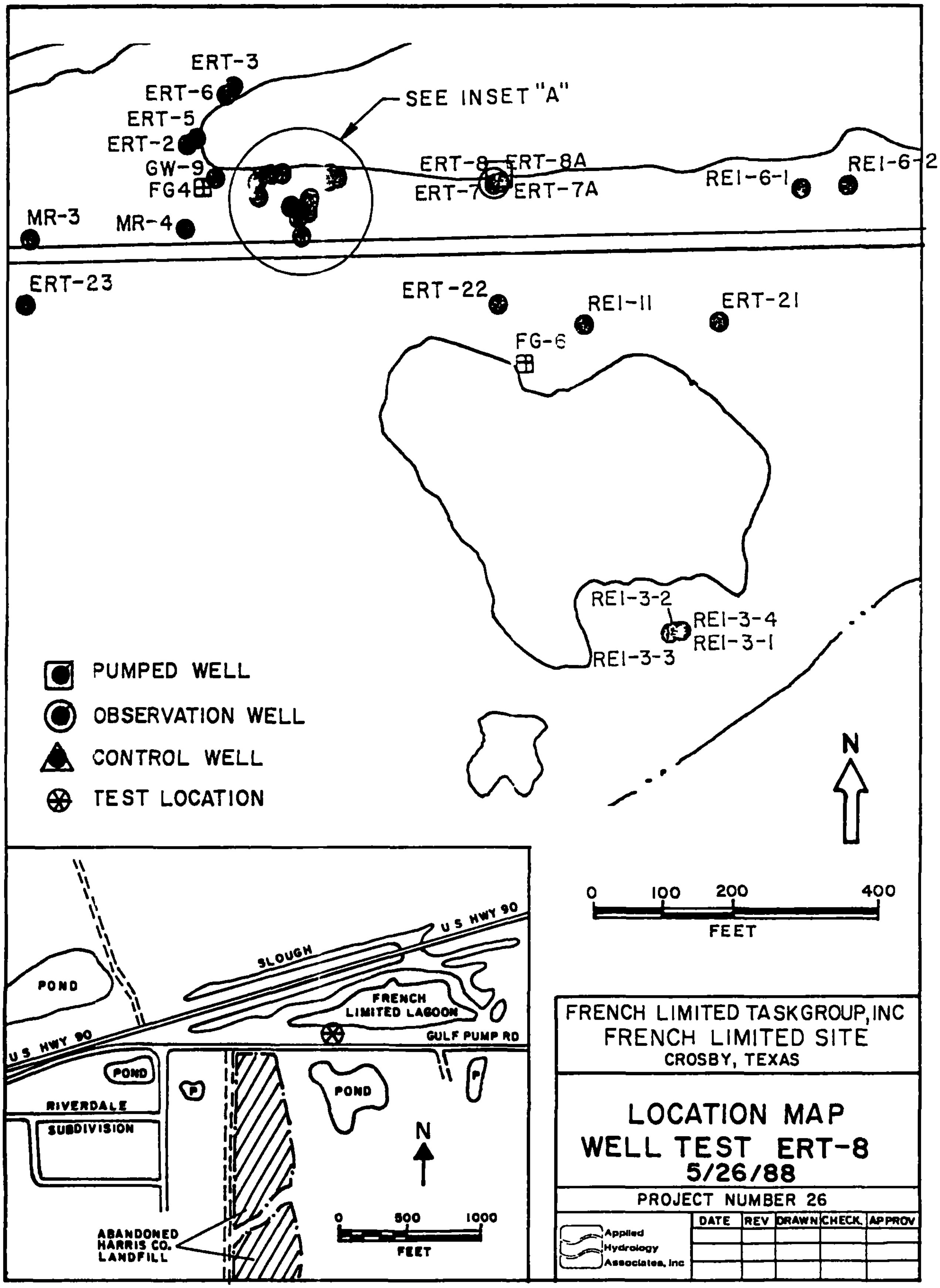
INTERPRETATION

The observation well, ERT-7, located 8 95 feet from the pumped well, ERT-8, showed a response to pumping that could be matched with a Theis curve using the nonproprietary IGWMC program THCVFIT (van der Heijde, 1987) for aquifer tests in which drawdown data were recorded at an observation well at a distance r from the pumped well. The program is based upon the Theis curve matching technique The program allows the user to interactively match a log-log plot of drawdown versus time to a Theis curve The program calculates the match point, the transmissivity and the storage coefficient given the constant pumping rate and the radial distance between the pumped well and the observation well

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate was 2197 gpd/ft and the average hydraulic conductivity was determined to be 3 $7\times10^{-3}$ cm/sec. and the storage coefficient was determined to be 0 022 The results of this analysis are attached

The results of the test are considered questionable because of the variable pumping rate and the lack of recovery measurements which would have been less sensitive to pumping rate fluctuations The u parameter value at the radius of the observation wells at the end of pumping was 0 22, which is much too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers

023703



ERT-3
ERT-6
SEE INSET "A"
ERT-5
ERT-2
GW-9
FG4
ERT-8
ERT-8A
ERT-7
ERT-7A
REI-6-1
REI-6-2
MR-3
MR-4
ERT-23
ERT-22
REI-11
ERT-21
FG-6
REI-3-2
REI-3-4
REI-3-1
REI-3-3
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0
100
200
400
FEET
US HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
US HWY 90
GULF PUMP RD
POND
P
RIVERDALE SUBDIVISION
POND
P
N
ABANDONED HARRIS CO. LANDFILL
0
500
1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-8
5/26/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK.
APPROV
Applied Hydrology Associates, Inc

023704

**ERT.**
A RESOURCE ENGINEERING COMPANY



## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-8

Client French LTD
Project Name French LTD
Project Location Crosby, Texas
Job Number 275-21 Boring No ert-8
Logged By D Morgan
Approved By G Spradley
Drilled By Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started 9/28/87 Date Completed 9/28/87
Method MR Total Depth 50'

WELL COMPLETION INFORMATION
Screen Dia 4" Length 29 5'
Slot Size 010 Type PVC
Casing Dia 4" Length 19 6'

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLE NO | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Fill, roadbase, gravel, silt, sand | | | | | | | | | |
| 3 | Silty Sand, gray | | | | | | | | | |
| 20 | Sand, fine to medium grained | | | | | | | | | |
| 28 | Clayey Silt, gray, some odor | | | | | | | | | |
| 47 | | 1 | SS | 50 | - | | | | | |
| 48 | Silty Clay, light gray, some tan mottles | | | | | | | | | |
| 50 | Stratigraphic breaks determined by advance of boring, cuttings, and information obtained from adjacent well ERT-7 | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

023705

**ERT.**
A RESOURCE ENGINEERING COMPANY



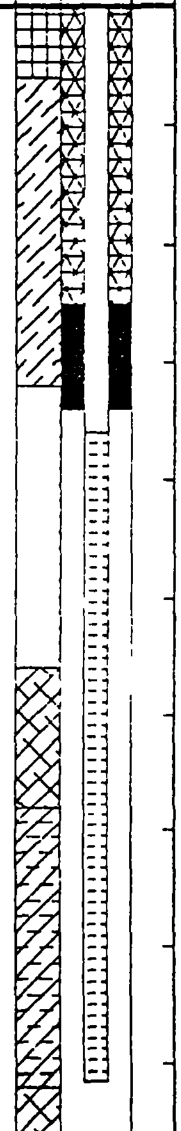
## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-7

Client French LTD
Project Name French LTD
Project Location Crosby, Texas
Job Number 275-21 Boring No ERT-7
Logged By D Morgan
Approved By G Spradley
Drilled By Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started 9/28/87 Date Completed 9/28/87
Method MR Total Depth 48

WELL COMPLETION INFORMATION
Screen Dia 4" Length 28 0'
Slot Size 010 Type PVC
Casing Dia 4" Length 17 7'

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLE NO | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT |
|---|---|---|---|---|---|---|
| | Fill roadbase, gravel, sand, silt | | | | | |
| | | 1 | ST | 80 | - | |
| 5 | Silty Sand, tan to brown/ gray, fine to medium grained some black sludge material | 2 | SS | 50 | 0.4 | |
| | | 3 | SS | 50 | 02 | |
| 10 | | 4 | SS | 45 | 02 | |
| | | 5 | SS | 25 | 02 | |
| | | 6 | SS | 50 | 06 | |
| 15 | | 7 | SS | 50 | 08 | |
| | Sand, fine to medium grained, gray, strong odor | 8 | SS | 13 | 04 | |
| 20 | | 9 | SS | NR | | |
| | | 10 | SS | 17 | - | |
| | | 11 | SS | 45 | - | |
| 25 | | 12 | SS | 25 | - | |
| | | 13 | SS | 25 | - | |
| 30 | Silty Clay, gray with some red/brown mottles stiff with some fine grained sand seams some odor | 14 | SS | 50 | - | |
| | | 15 | ST | 75 | - | |
| | | 16 | ST | 50 | - | |
| 35 | Clayey Silt, light gray, soft, saturated some odor | 17 | ST | 75 | - | |
| | | 19 | ST | NR | | |
| 40 | | 20 | ST | 75 | - | |
| | | 21 | SS | 50 | - | |
| | | 22 | SS | 65 | - | |
| 45 | | 23 | ST | 50 | - | |
| | Silty Clay, light gray, stiff, some tan mottles, no odor | 24 | ST | 84 | - | |
| 50 | BORING TERMINATED AT 48 0' | | | | | |
| 55 | | | | | | |



SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE

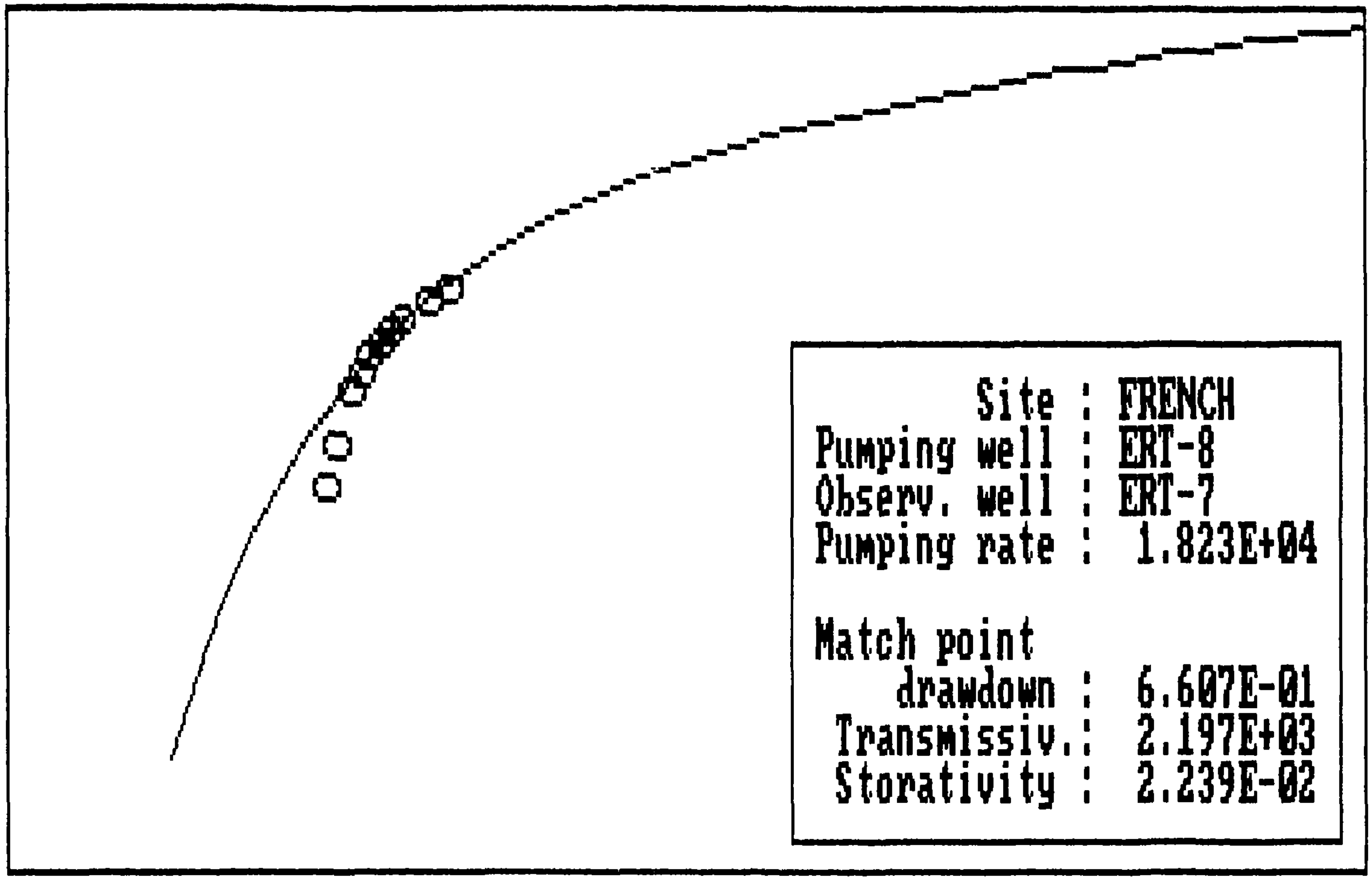
BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

FRENCH LIMITED
CROSBY, TX

ERT-7 OBSERVATION
ERT-8 PUMPED
DATE: 5/26/88
STATIC WATER LEVEL: 4.80 FEET. WAS 4.24 FEET PRIOR TO PUMPING YESTERDAY.
PUMPING RATE: 12.66 GPM = 18,230.4 GPD
DISTANCE TO OBSERVATION POINT: 8.95 FEET
TOTAL DEPTH OF WELL: 43.25 FEET
AQUIFER THICKNESS: 43.25 - 4.80 = 38.45 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 3.33 | | 4.94 | 0.14 | 0.14 | 5 gal/23.7 sec |
| 3.58 | | 5.00 | 0.20 | 0.20 | |
| 4.12 | | 5.10 | 0.30 | 0.30 | |
| 4.42 | | 5.15 | 0.35 | 0.35 | |
| 4.70 | | 5.20 | 0.40 | 0.40 | |
| 5.23 | | 5.25 | 0.45 | 0.45 | |
| 5.78 | | 5.30 | 0.50 | 0.50 | |
| 6.40 | | 5.35 | 0.55 | 0.55 | |
| 8.13 | | 5.45 | 0.65 | 0.64 | |
| 9.52 | | 5.50 | 0.70 | 0.69 | |
| 9.60 | | | | | Pump Off |

Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End

Program THCVFIT Version 1.0 IGWMC Indianapolis - Delft

INITIAL DATA:

Site name: FRENCH
Name of pumping well: ERT-8
Name of observation well: ERT-7

Constant pumping rate.................Q = 18230 gal/day
Radial distance to observation well...R = 8.95 ft
Matchpoint drawdown.................SA = .6606935 ft
Number of response pairs............NUM = 10

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown(ft) |
|---|---|---|---|---|---|
| 1 | 3.33 | 0.14 | 2 | 3.58 | 0.20 |
| 3 | 4.12 | 0.30 | 4 | 4.42 | 0.35 |
| 5 | 4.70 | 0.40 | 6 | 5.23 | 0.45 |
| 7 | 5.78 | 0.50 | 8 | 6.40 | 0.55 |
| 9 | 8.13 | 0.64 | 10 | 9.52 | 0.69 |

CALCULATED PARAMETERS

Transmissivity TRANS = 2.1968E+03gal/day/ft
Storage coefficient STOR = 2.2385E-02

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 25, 1988

PUMPED WELL: ERT-9

OBSERVATION WELLS ERT-10, radial distance 9 0 feet

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of wells ERT-9 and ERT-10 precede the aquifer test data which follow Prior to purging well ert-9, the depth to static water level below the top of casing in observation well ERT-10 was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder periodically during the purging operation The well bore in well ERT-9 was purged nearly dry after 1 33 minutes of pumping, in that period, one flow measurement of 12 66 gpm was taken via a five-gallon bucket and stop watch The pump was stopped and the well allowed to recover for nine or ten minutes before the well bore was purged again This continued until the well bore was purged three times A weighted mean pumping rate of 3 22 gpm was estimated from the times the pump was operating assuming the pump rate was 12 66 gpm while the pump was operating Obviously, the pumping rate varied considerably during the purging operation and the average pumping rate is a crude estimate at best Recovery measurements were taken for only three minutes

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns Water levels in the pumped well were not measured during this test

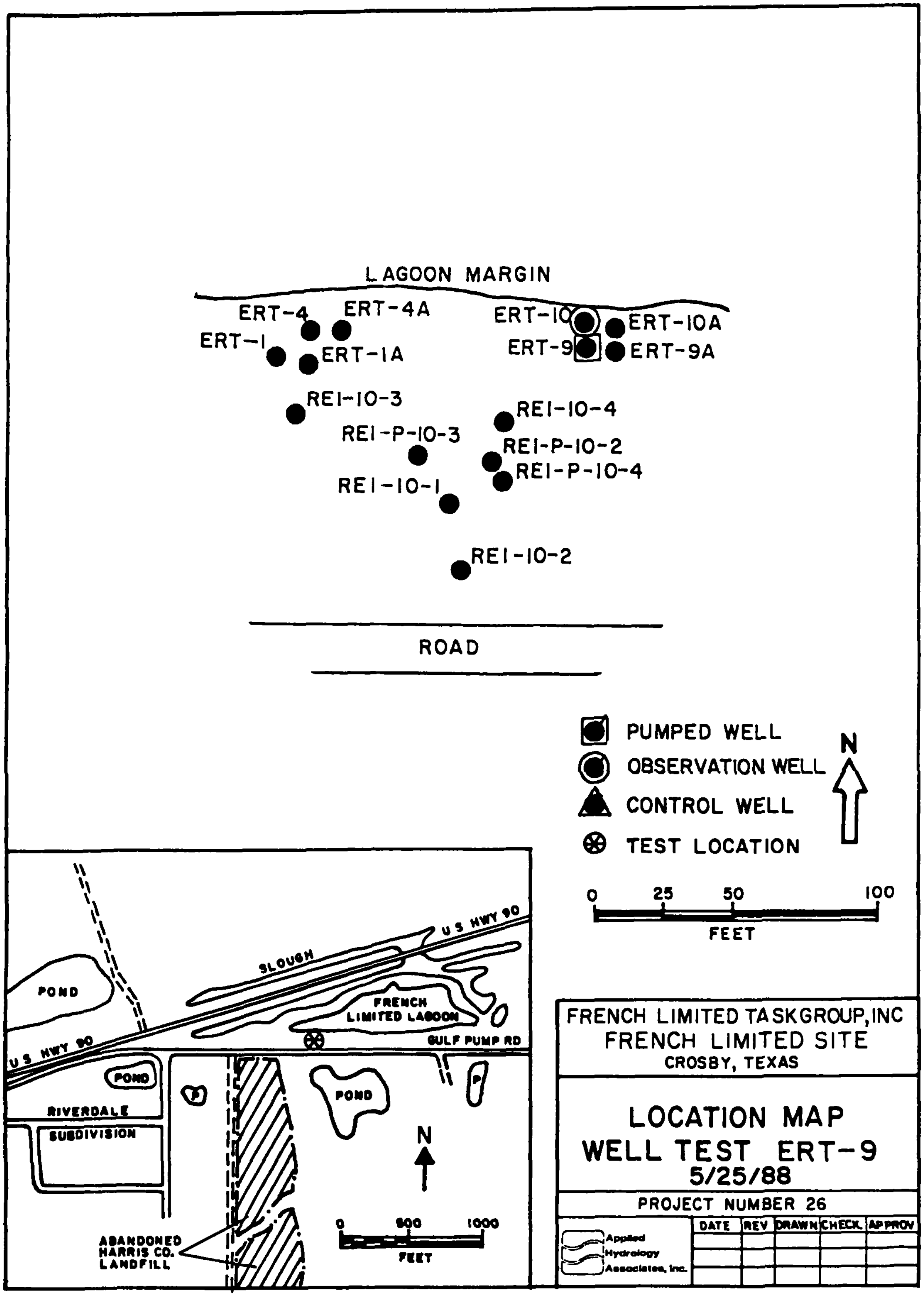
Water produced from the test was dumped directly into the French Limited Lagoon.

INTERPRETATION

The observation well ERT-10 was located nine feet from the pumped well The attempt to match the response to pumping with a Theis curve using the nonproprietary IGWMC program THCVFIT (van der Heijde, 1987) is attached The fit is not good as might be expected with the variable pumping rate

The results presented for this test are not considered representative because of the poor fit to the Theis curve and the variable pumping rate

023711



LAGOON MARGIN
ERT-4
ERT-4A
ERT-1
ERT-1A
ERT-10
ERT-10A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI-P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 25 50 100
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD
POND
RIVERDALE SUBDIVISION
POND
P
N
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-9
5/25/88
PROJECT NUMBER 26
DATE REV DRAWN CHECK APPROV
Applied Hydrology Associates, Inc.

ERT 023712

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-9

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No: 275-23-01   Boring No: ERT-9
Logged By: Steve Preston
Approved By:
Drilled By: FSI, Inc   Driller's Name: R Preston

**DRILLING AND SAMPLING INFORMATION**

Date Started: 11-15-87   Date Completed: 11-15-87
Method: Mud Rotary   Total Depth: 54 5 feet

**WELL COMPLETION INFORMATION**

Screen Dia: 4-inch Ø   Length: 30 0 feet
Slot Size: 0 010-inch   Type: PVC
Casing Dia: 4-inch Ø   Length: 22 0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft 2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Road fill material (1 0') | | | | | | | | | |
| | Gray fine to medium silty sand | | | | | | | | | |
| 5 | | | | | | | | | | |
| | - Medium to coarse sand | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | (52 5') ~~(52.0')~~ | | | | | | | | | |
| | - Gray fine silty sand | | | | | | | | | |
| | - Gray silty clay (54 5') | 9 | SS | 54 5 | - | | 100 | - | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE

SS DRIVEN SPLIT SPOON   CA - CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE   RC - ROCK CORE

BORING METHOD

HSA - HOLLOW STEM AUGERS   DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS   MD - MUD DRILLING

023713

# ERT

A RESOURCE ENGINEERING COMPANY



## BORING LOG AND CONSTRUCTION OF ERT-10

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No: 273-23-01 Boring No: ERT-10
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc Driller's Name: R Spencer

DRILLING AND SAMPLING INFORMATION

Date Started: 11-14-87 Date Completed: 11-14-87
Method: Mud Rotary Total Depth: 49 5 feet

WELL COMPLETION INFORMATION

Screen Dia: 4-inch Ø Length: 30 0 feet
Slot Size: 0 010 inch Type: PVC
Casing Dia: 4-inch Ø Length: 20 0 feet

SURFACE ELEVATION

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft 2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Road fill material (1 0') | | | | | | | | | |
| | Gray silty medium to fine sand (33 0') | | | | | | | | | |
| 33 | Gray fine to medium sandy silt with clay lenses (35 0') | 10 | S S | 35 | | - | 100 | 3- 2 | | |
| 35 | - Gray coarse sand and gravel (52 0') | | | | | | | | | |

SAMPLER TYPE

SS DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD

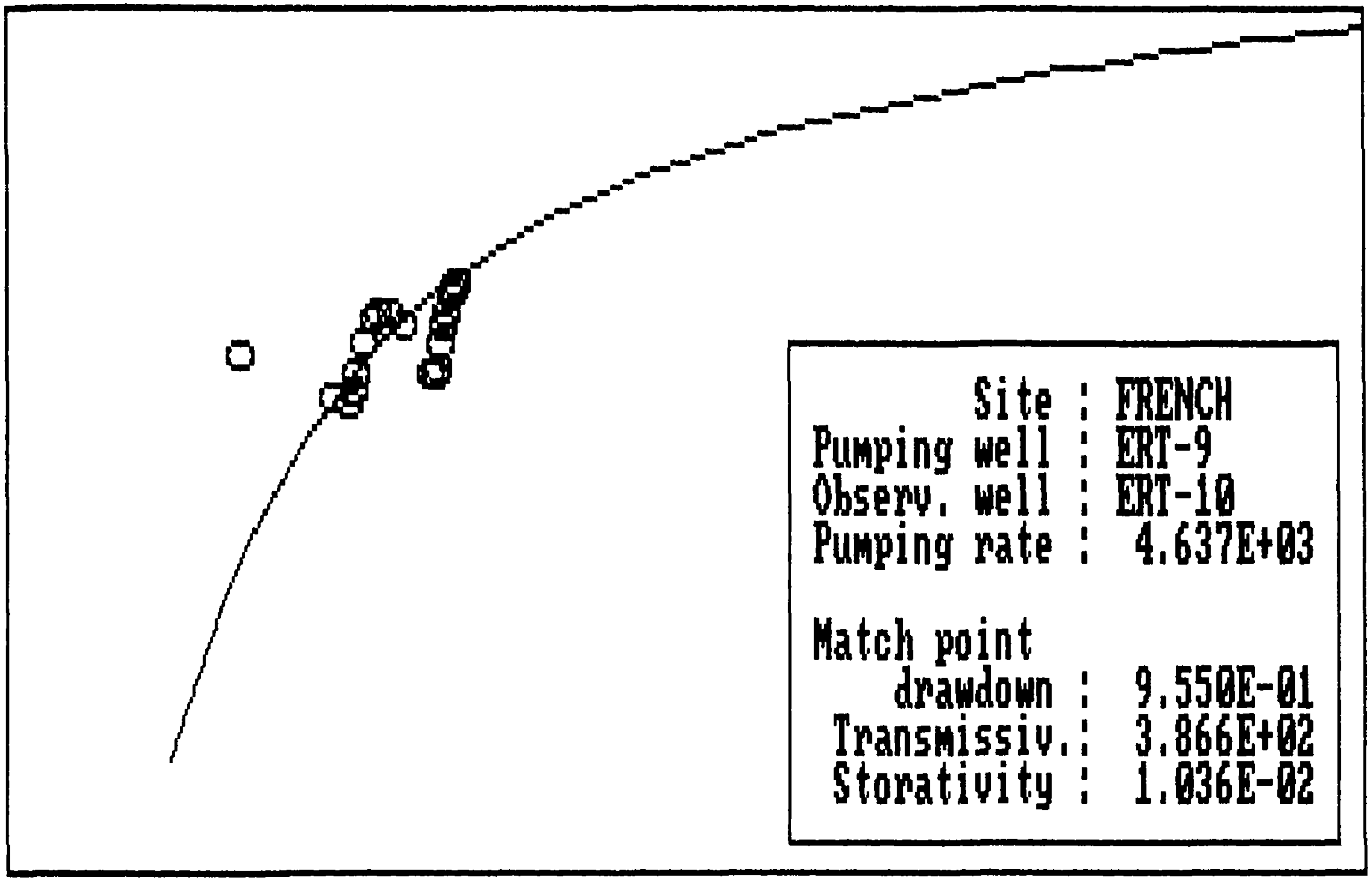
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

FRENCH LIMITED
CROSBY, TX

ERT-10 OBSERVATION
ERT-9 PUMPED
DATE: 5/25/88
STATIC WATER LEVEL: 5.35 FEET
PUMPING RATE: 3.22 GPM = 4636.8 GPD (WEIGHTED MEAN)
DISTANCE TO OBSERVATION POINT: 9.00 FEET
TOTAL DEPTH OF WELL: 48.10 FEET
AQUIFER THICKNESS: 48.10 - 5.35 = 42.75 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 1.33 | | | | | Pump Off, Well Dry |
| 4.25 | 2.92 | 5.95 | 0.60 | 0.60 | |
| 9.25 | | 5.78 | 0.43 | 0.43 | |
| 10.00 | | | | | Pump On |
| 10.63 | | 5.75 | 0.40 | 0.40 | |
| 10.97 | | 5.80 | 0.45 | 0.45 | |
| 11.25 | | 5.85 | 0.50 | 0.50 | |
| 12.03 | | 6.00 | 0.65 | 0.65 | Pump Off |
| 13.13 | | 6.15 | 0.80 | 0.79 | |
| 13.70 | | 6.20 | 0.85 | 0.84 | |
| 15.40 | | 6.20 | 0.85 | 0.84 | |
| 17.28 | | 6.10 | 0.75 | 0.74 | |
| 21.98 | | 5.87 | 0.52 | 0.52 | |
| 22.42 | | | | | Pump On |
| 23.02 | | 5.85 | 0.50 | 0.50 | |
| 23.45 | | 5.90 | 0.55 | 0.55 | |
| 23.98 | | 6.00 | 0.65 | 0.65 | |
| 24.53 | | 6.10 | 0.75 | 0.74 | |
| 25.17 | | 6.20 | 0.85 | 0.84 | |
| 25.55 | | | | | Pump Off |
| 25.90 | | 6.30 | 0.95 | 0.94 | |
| 26.35 | | 6.35 | 1.00 | 0.99 | |
| 27.25 | | 6.40 | 1.05 | 1.04 | |

Curve matching - English units




F2->Plot Theis F3->Plot data F4->Match F5->T,S F6->Print F7->End



023715

Program THCVFIT Version 1.0 IGWMC Indianapolis - Delft

INITIAL DATA:

Site name: FRENCH
Name of pumping well: ERT-9
Name of observation well: ERT-10

Constant pumping rate.................Q = 4636.8 gal/day
Radial distance to observation well...R = 9 ft
Matchpoint drawdown..................SA = .9549925 ft
Number of response pairs............NUM = 19

AQUIFER-TEST TIME-DRAWDOWN DATA

| # | Time (min) | Drawdown(ft) | # | Time (min) | Drawdown(ft) |
|---|---|---|---|---|---|
| 1 | 4.25 | 0.60 | 2 | 9.25 | 0.43 |
| 3 | 10.63 | 0.40 | 4 | 10.97 | 0.45 |
| 5 | 11.25 | 0.50 | 6 | 12.03 | 0.65 |
| 7 | 13.13 | 0.79 | 8 | 13.70 | 0.84 |
| 9 | 15.40 | 0.84 | 10 | 17.28 | 0.74 |
| 11 | 21.98 | 0.52 | 12 | 23.02 | 0.50 |
| 13 | 23.45 | 0.55 | 14 | 23.98 | 0.65 |
| 15 | 24.53 | 0.74 | 16 | 25.17 | 0.84 |
| 17 | 25.90 | 0.94 | 18 | 26.35 | 0.99 |

CALCULATED PARAMETERS

Transmissivity TRANS = 3.8657E+02gal/day/ft
Storage coefficient STOR = 1.0361E-02

023717

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST: May 24, 1988

PUMPED WELL: ERT-23

OBSERVATION WELLS: ERT-23

CONTROL WELLS: none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-23 precede the aquifer test data which follow Prior to purging the well, the depth to static water level below the top of casing in the well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a pump and water level measurements were taken with the electric sounder about one or two times per minute until the submersible pump was shut off at 8 52 minutes after the start of pumping Recovery measurements were taken for almost 20 minutes following the test Because of the short duration of the test, only one flow measurement was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where. $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test.

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

INTERPRETATION.

Water level measurements were performed only on the pumped well, ERT-23 The adjusted drawdown data from the pumped well were analyzed using the nonproprietary program JACOBFIT in the PUMPTEST package (Beljin, 1986) available from the International Ground Water Modeling Center The program is based on the Cooper and Jacob (1946) approximation of the Theis

023713

equation. The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0.01:

where r is the radial distance between the pumped well and observation well (feet),
S is the storage coefficient (unitless)
T is the transmissivity ($ft^2$/day), and
t is the time since pumping started (days).

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line The recovery data were analyzed using a second IGWMC program called RECOVERY (Beljin, 1986) based upon the Theis (1935) recovery method. The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line.

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate is 7133 gpd/ft using the drawdown data and 8420 gpd/ft using the recovery data The average hydraulic conductivity was determined to be 8 $4 \times 10^{-3}$ cm/sec and 9 $9 \times 10^{-3}$ cm/sec. respectively for the drawdown and recovery results. The storage coefficient could not be determined from the single well test. The results of this analysis are attached

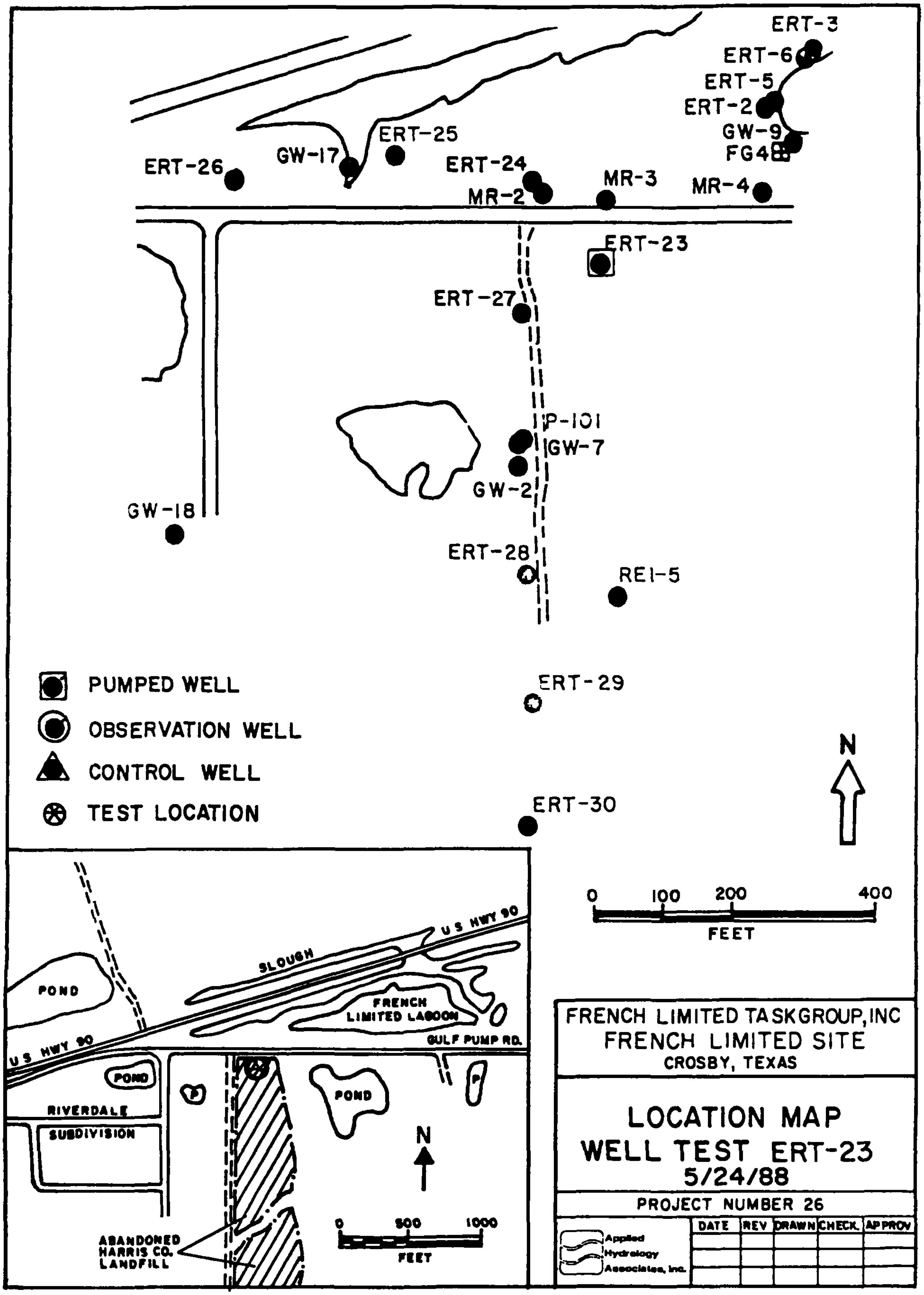
The results of the test are considered reasonable given the good comparison between the drawdown and recovery results and the relatively high specific capacity It is likely that the initial pumping rate is representative of the entire pumping period because of the limited drawdown in the pumped well Well bore storage effects were significant for only the first 1 35 minutes of pumping The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2 1 and shown below

$$t_c = 0.6(16-1)/(11.26/1.93^*) = 1.35 \text{ minutes}$$

* drawdown interpolated at 1 33 minutes into the test

Consequently, the drawdown data for the first 1.35 minutes should not be used for interpretation. Likewise, the first 1.35 minutes of the recovery data should not be used.

023719


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-4
MR-2
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
POND
RIVERDALE
SUBDIVISION
POND
P
N
0 500 1000
FEET
ABANDONED HARRIS CO. LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-23
5/24/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV
DRAWN
CHECK.
APPROV

023770

ERT

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-23

Client: APCO Chemical Company
Project Name: French Limited Site
Project Location: Crosb , Texas
Job No: 275-23-01 Boring No: ERT-23
Logged By: Steve Preston
Approved By:
Drilled By: PSI Inc Driller s Name: R Spencer

DRILLING AND SAMPLING INFORMATION
Date Started: 12-28-87 Date Completed: 12-28-87
Method: Mud Rotary Total Depth: 60.0 feet

WELL COMPLETION INFORMATION
Screen Dia: 4-inch Ø Length: 40 0 feet
Slot Size: 0 010-inch Type: PVC
Casing Dia: 4-inch Ø Length: 15 0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft 2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown clay, gravel and glass pieces with trash material (Fill material) | | | | | | | | | |
| 5 | (8 0') | | | | | | | | | |
| | Dark brown sandy clay with gravel (CL) (10 0') | - | ST | 8 5 / 10 0 | - | - | | - | | |
| 10 | Medium dense light gray fine to medium sand with occassional gravel (SP) | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | - | SS | 18 5 / 20 0 | - | 9/11/2 | | 0 6 | | |
| | (22 0') | | | | | | | | | |
| | Stiff brown clay with occassional gravel (CH) | - | ST | 23 0 / 25 0 | 3 0 | - | | 1 1 | | |
| 25 | | | | | | | | | | |
| | - Olive gra and brown from 29 0' | 1-6 | ST | 28 0 / 30 0 | 3 0 | - | | 0 1 | | |
| 30 | (33 0') | | | | | | | | | |
| | Stiff gray and red silty clay (CL) (34 8') | - | ST | 33 0 / 35 0 | 2 5 | - | | 1 1 | | |
| 35 | Light gray silty fine sand to fine sand (SM-SP) | | | | | | | | | |
| | | - | ST | 38 5 / 40 0 | - | - | | - | | |
| 40 | | | | | | | | | | |
| | - Gray and red clay layer from 44 0' to 44 2' | - | ST | 43 5 / 45.0 | - | - | | 3 1 | | |
| 45 | - 1-inch silt layers at 48 0' ~~from 48.0' to 5_ 0'~~ | | | | | | | | | |
| | | – | ST | 48 0 / 50 0 | – | – | | 12 1 | | |
| 50 | | | | | | | | | | |
| | | J-7 | ST | 53 0 / 55 0 | – | – | | 1 1 | | |
| 55 | - Red clay pockets and partings from 55 0' (57 0') | | | | | | | | | |
| | Very stiff red and gray clay with silt pockets (CH) (60 0') | J-8 | ST | 58 5 / 60 0 | 3 5 | – | | 1 1 | | |

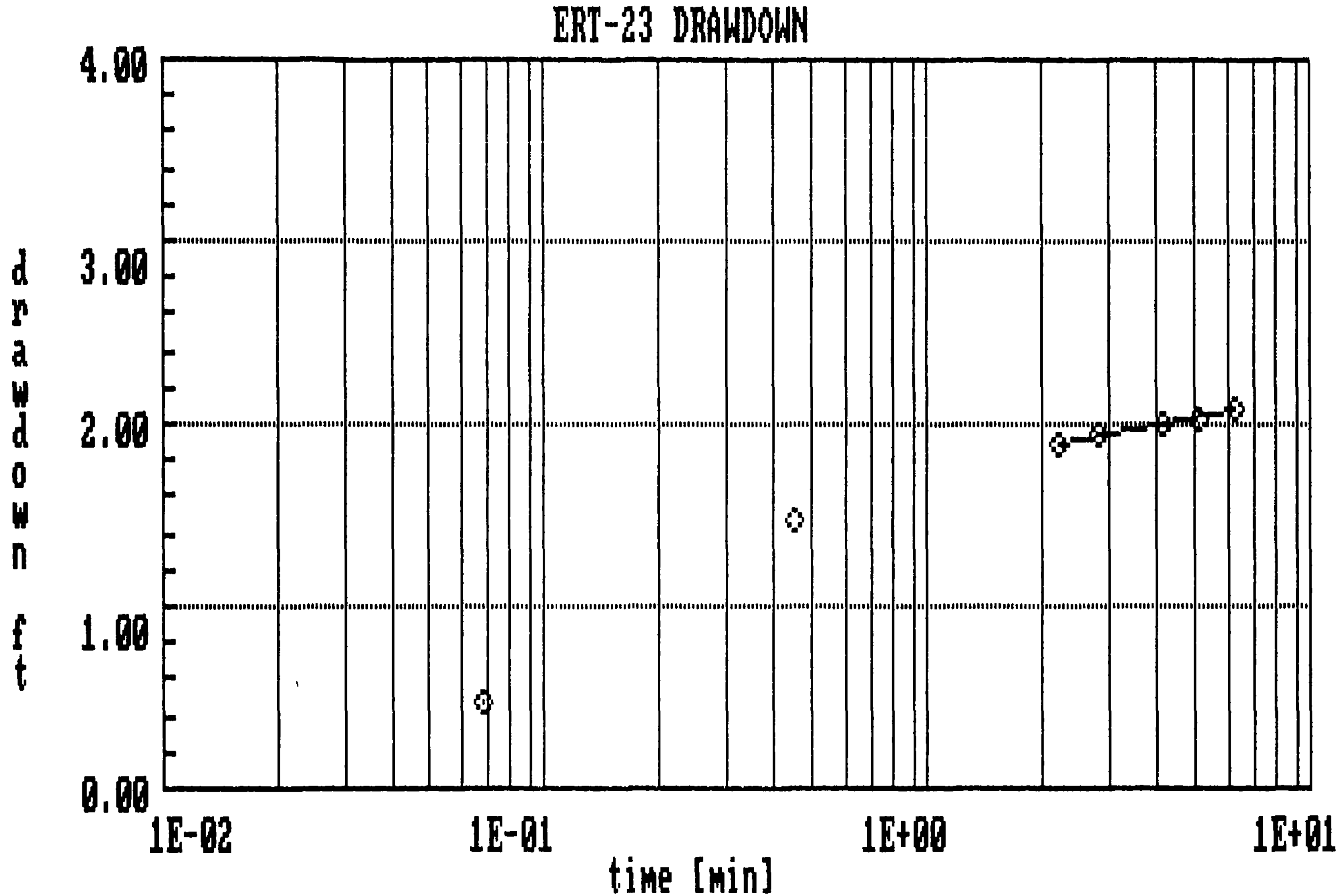
SAMPLER TYPE
SS DRIVEN SPLIT SPOON CA CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

FRENCH LIMITED
CROSBY, TX
WELL ERT-23

DATE: 5/24/88
STATIC WATER LEVEL: 6.52 FEET
PUMPING RATE: 11.26 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 58.76 FEET (SOUNDED)
AQUIFER THICKNESS: 58.76 - 6.52 = 52.24 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 0.07 | | 7.0 | 0.48 | 0.48 | |
| 0.45 | | 8.0 | 1.48 | 1.46 | |
| 2.20 | | 8.45 | 1.93 | 1.89 | |
| 2.82 | | 8.50 | 1.98 | 1.94 | |
| 4.13 | | 8.55 | 2.03 | 1.99 | 5g/26.65 sec |
| 5.13 | | 8.60 | 2.08 | 2.04 | |
| 6.40 | | 8.65 | 2.13 | 2.09 | |
| 8.52 | | | | | Pump Off |
| 9.00 | 0.48 | 7.00 | 0.48 | 0.48 | |
| 9.33 | 0.82 | 6.90 | 0.38 | 0.38 | |
| 10.05 | 1.53 | 6.80 | 0.28 | 0.28 | |
| 10.67 | 2.15 | 6.75 | 0.23 | 0.23 | |
| 11.45 | 2.93 | 6.70 | 0.18 | 0.18 | |
| 13.25 | 4.73 | 6.65 | 0.13 | 0.13 | |
| 16.73 | 8.22 | 6.60 | 0.08 | 0.08 | |
| 26.85 | 18.33 | 6.55 | 0.03 | 0.03 | |




FILE:

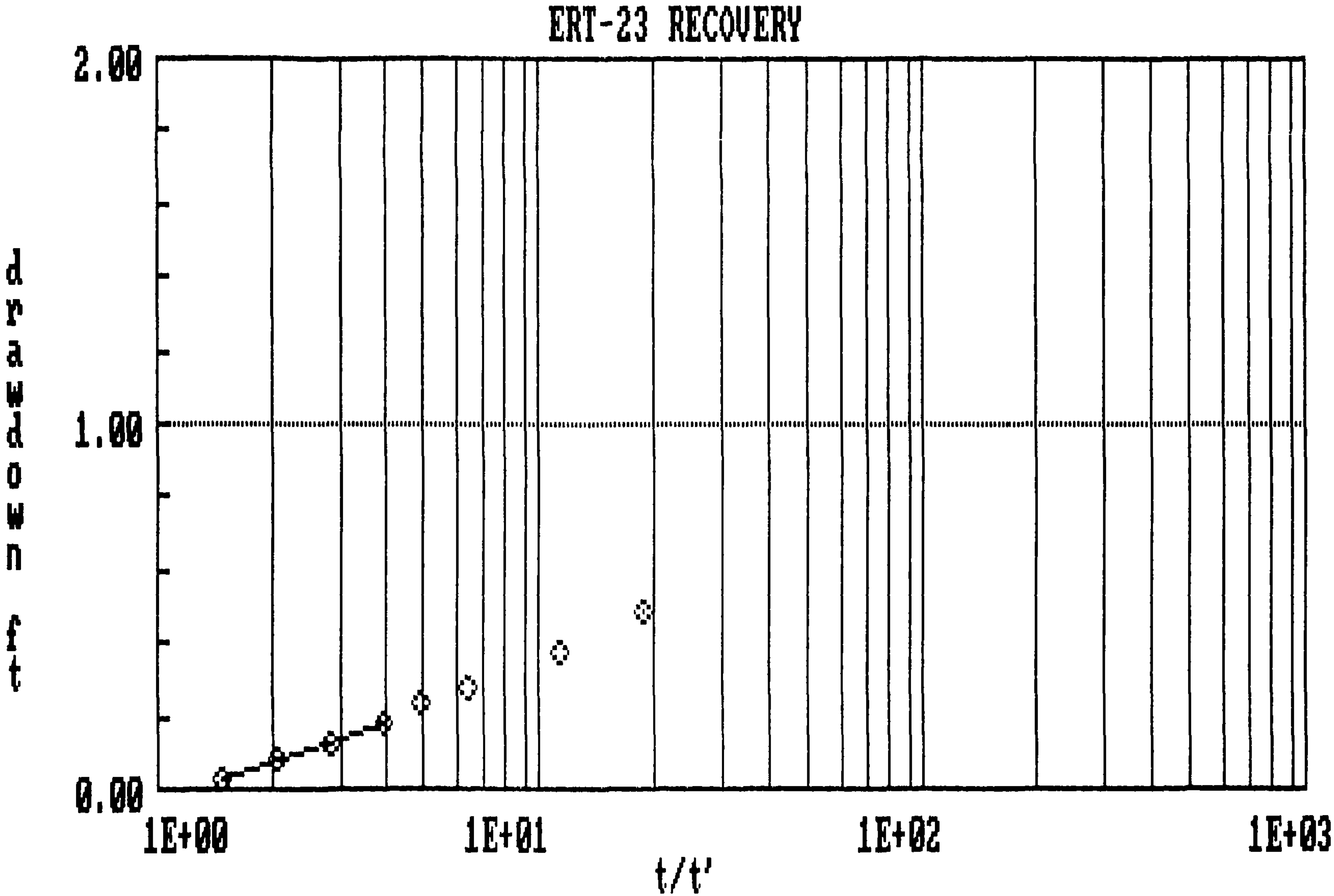
023772

R-81

```
**********************************************************
*                                                        *
*             program:  JacobFit                         *
*             version:  IBM PC 1.0                       *
*                                                        *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S        *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.     *
*                                                        *
**********************************************************

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-23
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  6.52 [ft]
DISCHARGE RATE............... =  11.26 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]
```

| NO | TIME [min] | DRAWDOWN [ft] | u | DEVIATION |
|---|---|---|---|---|
| 1 | 0.07 | 0.480 | .000E+00 | +.000E+00 |
| 2 | 0.45 | 1.460 | .000E+00 | +.000E+00 |
| 3 | 2.20 | 1.890 | .164E-04 | +.103E-02 |
| 4 | 2.82 | 1.940 | .128E-04 | +.612E-02 |
| 5 | 4.13 | 1.990 | .872E-05 | -.129E-01 |
| 6 | 5.13 | 2.040 | .702E-05 | -.212E-02 |
| 7 | 6.40 | 2.090 | .563E-05 | +.787E-02 |

```
TRANSMISSIVITY T = .110E-01 [ft2/s]
               T =   7133 [gpd/ft]
STORATIVITY    S = .954E-04

DATA SEGMENT ANALYZED :
  - starting with data pair  3
  - ending   with data pair  7

DETERMINATION COEFFICENT = .9891414

*******************************************************
```




FILE: ERT23R.DAT

```
**********************************************************
*                                                        *
*              program:  Recovery                        *
*              version:  IBM PC 1.0                      *
*                                                        *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S        *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.     *
*                                                        *
**********************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-23
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  6.52 [ft]
DISCHARGE RATE...............  =  11.26 [gpm]
DURATION OF PUMPING PERIOD... =  8.520001 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 0.48 | 9.00 | 18.75 | 0.480 | +.000E+00 |
| 2 | 0.82 | 9.34 | 11.39 | 0.380 | +.000E+00 |
| 3 | 1.53 | 10.05 | 6.57 | 0.280 | +.000E+00 |
| 4 | 2.15 | 10.67 | 4.96 | 0.230 | +.580E-02 |
| 5 | 2.93 | 11.45 | 3.91 | 0.180 | -.315E-03 |
| 6 | 4.73 | 13.25 | 2.80 | 0.130 | +.701E-03 |
| 7 | 8.22 | 16.74 | 2.04 | 0.080 | -.439E-03 |
| 8 | 18.33 | 26.85 | 1.46 | 0.030 | +.541E-04 |

TRANSMISSIVITY T = .130E-01 [ft2/s]
T = 8420 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair 5
- ending with data pair 8

DETERMINATION COEFFICENT = .9999377

**********************************************************

# FRENCH LIMITED SITE
# PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST: May 24, 1988

PUMPED WELL. ERT-24

OBSERVATION WELLS. ERT-24

CONTROL WELLS none

## BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-24 precede the aquifer test data which follow Prior to purging the well the depth to static water level below the top of casing in the well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a pump and water level measurements were taken with the electric sounder about one or two times per minute until the submersible pump was shut off at nine minutes after the start of pumping Recovery measurements were taken for about two hours following the test Because of the short duration of the test, only one flow measurements was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test.

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon.

## INTERPRETATION:

Water level measurements were performed on the pumped well, ERT-24. The adjusted drawdown data from the pumped well were analyzed using the nonproprietary program JACOBFIT in the PUMPTEST package (Beljin, 1986) available from the International Ground Water Modeling Center The program is based on the Cooper and Jacob (1946) approximation of the Theis equation. The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01.

where $r$ is the radial distance between the pumped well and observation well (feet),
$S$ is the storage coefficient (unitless)
$T$ is the transmissivity ($ft^2$/day), and
$t$ is the time since pumping started (days)

The parameter "u" is less than 0.01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line The IGWMC program RECOVERY (Beljin, 1986) based upon the Theis (1935) recovery method was used to analyze the recovery data The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line.

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate is 2448 gpd/ft using the drawdown data and 2922 gpd/ft using the recovery data The average hydraulic conductivity was determined to be 3 $3\text{x}10^{-3}$ cm/sec and 3 $9\text{x}10^{-3}$ cm/sec respectively for the drawdown and recovery results The storage coefficient could not be determined from the single well test The results of this analysis are attached

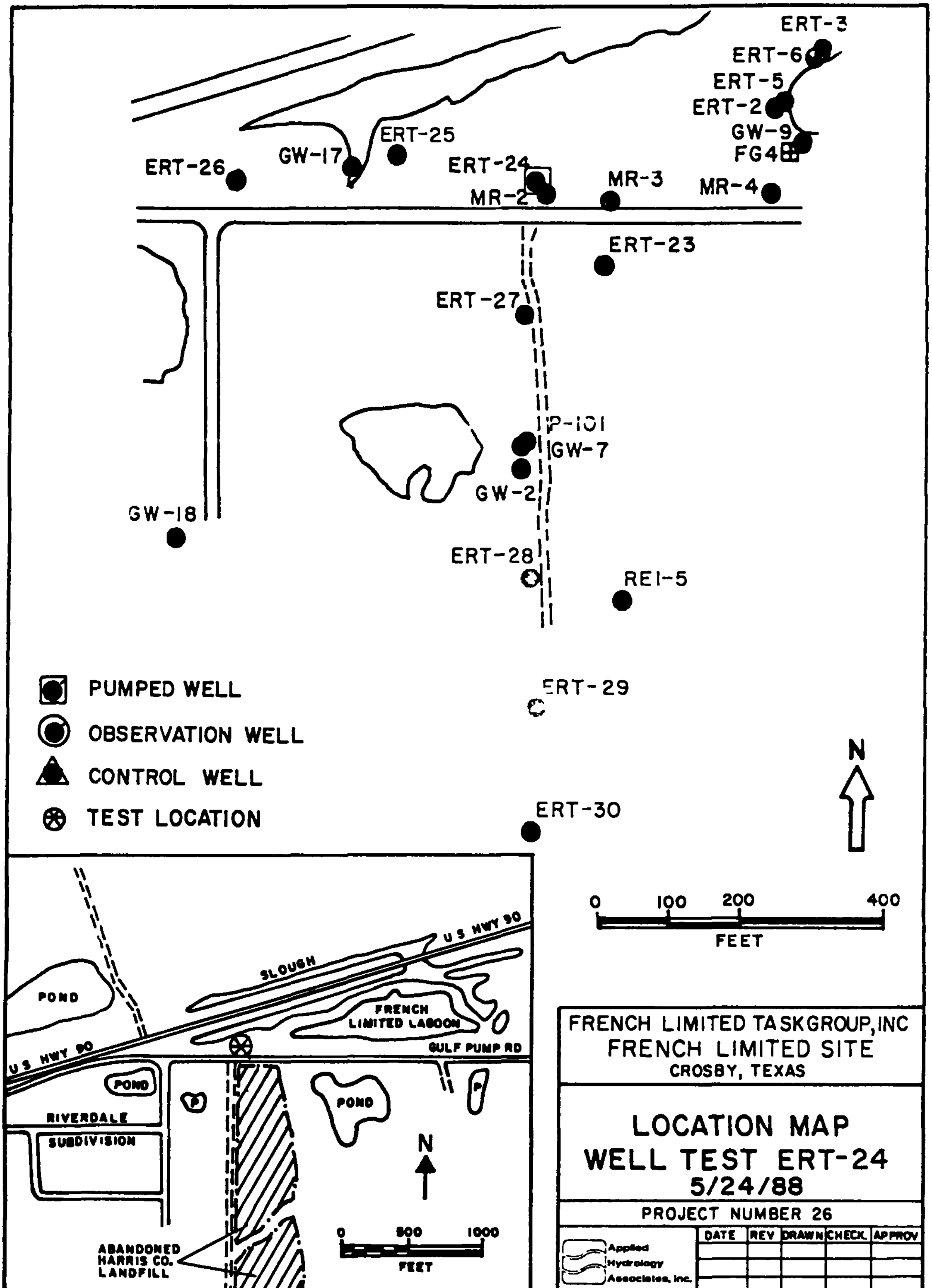
The results of the test are considered reasonable given the good comparison between the drawdown and recovery results and the relatively high specific capacity It is likely that the initial pumping rate is representative of the entire pumping period because of the limited drawdown in the pumped well Well bore storage effects were significant for only the first five minutes of pumping The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2.1 and shown below·

$t_c$ - 0.6(16-1)/(10 75/6 $03^*$) - 5 05 minutes

* drawdown interpolated at 5 minutes into the test

Consequently, the drawdown data for the first five minutes should not be used for interpretation. Likewise, the first five minutes of the recovery data should not be used.

0237 3



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-4
MR-2
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE SUBDIVISION
P
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-24
5/24/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK.
APPROV
Applied Hydrology Associates, Inc.

**ERT** 023779

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-24

Client ARCO CHEMICAL COMPANY
Project Name FRENCH LIMITED SITE
Project Location CROSBY, TEXAS
Job No 775-23-01 Boring No ERT-24
Logged By STEVE PRESTON
Approved By RAAJ PATEL
Drilled By GULF COAST DRILLING Driller's Name JIM TURNER

**DRILLING AND SAMPLING INFORMATION**
Date Started 12-30-87 Date Completed 12-31-87
Method Mud Rotary Total Depth 50 0 feet

**WELL COMPLETION INFORMATION**
Screen Dia 4-inch Ø Length 35 0 feet
Slot Size 0 010-inch Type PVC
Casing Dia 4-inch Ø Length 10 0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO | SAMPLE TYPE | SAMPLE DEPTH (In feet) | POCKET PENETROMETER (Tons/Ft 2) | BLOW COUNTS | % RECOVERY | HNU VALUE (In units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Dark gray fine to medium silty sand with roots (SM) | - | ST | 0 0 / 2 0 | - | - | | 0 5 | | |
| 5 | | - | ST | 3 0 / 5 0 | - | - | | 0 5 | | |
| 10 | - Tan fine to medium (9 5') | - | ST | 8 5 / 10 0 | - | - | | 0 5 | | |
| | Medium dense light olive gray fine to medium clayey sand slightly silty (SC) (14 0') | | | | | | | | | |
| 15 | Medium dense light gray fine to coarse sand (wet/freable) (SP) | - | SS | 13 5 / 15 0 | - | 5/10/16 | | 0 5 | | |
| 20 | (21 0') | - | SS | 18 5 / 20 0 | - | 7/12/9 | | - | | |
| 25 | [illegible] stiff gray clay (CH) | - | ST | 23 0 / 25 0 | 3 25 | - | | 0 0 | | |
| 30 | - [illegible] slickensides from 30 0' | - | ST | 28 0 / 30 0 | 3 75 | - | | - | | |
| | (33 0') | | | | | | | | | |
| 35 | Light gray and tan clayey silt with clay pockets and partings (ML) | -1 | ST | 33 0 / 35 0 | - | - | | 0 0 | | |
| 40 | - Increasing clay content from 40 0' | - | ST | 38 0 / 40 0 | - | - | | 0 0 | | |
| 45 | (46 0') | - | ST | 43 0 / 45 0 | - | - | | 0 0 | | |
| 50 | Very stiff dark red and gray clay with silt partings and slickensides (CH) (50 0') | J-2 | ST | 48 5 / 50 0 | 3 70 | - | | 0 0 | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE
SS DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST PRESSED SHELBY TUBE RC - ROCK CORE

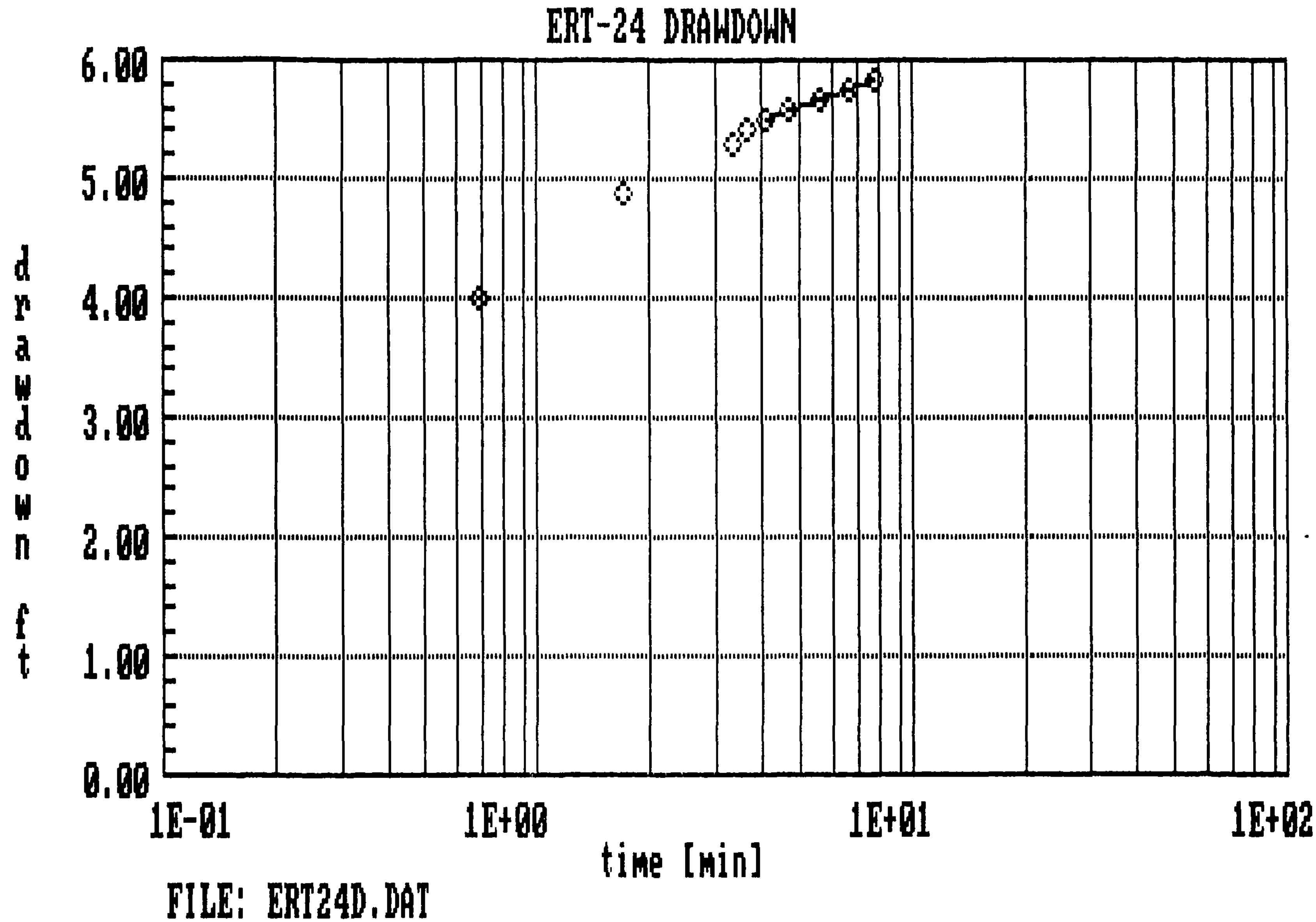
BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023730

FRENCH LIMITED
CROSBY, TX
WELL ERT-24

DATE: 5/24/88
STATIC WATER LEVEL: 3.80 FEET
PUMPING RATE: 10.75 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 45.9 FEET (SOUNDED)
AQUIFER THICKNESS: 45.9 - 3.80 = 42.1 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 0.71 | | 8.00 | 4.20 | 3.99 | |
| 1.71 | | 9.00 | 5.20 | 4.88 | |
| 3.31 | | 9.50 | 5.70 | 5.31 | |
| 3.63 | | 9.60 | 5.80 | 5.40 | |
| 4.11 | | 9.70 | 5.90 | 5.49 | 5 gal/27.9 secs |
| 4.73 | | 9.80 | 6.00 | 5.57 | |
| 5.66 | | 9.90 | 6.10 | 5.66 | |
| 6.78 | | 10.00 | 6.20 | 5.74 | |
| 7.98 | | 10.10 | 6.30 | 5.83 | |
| 9.00 | | | | | Pump Off |
| 9.23 | 0.23 | 8.00 | 4.20 | 3.99 | |
| 9.38 | 0.38 | 7.00 | 3.20 | 3.08 | |
| 9.66 | 0.67 | 6.00 | 2.20 | 2.14 | |
| 9.96 | 0.97 | 5.50 | 1.70 | 1.67 | |
| 10.05 | 1.05 | 5.40 | 1.60 | 1.57 | |
| 10.13 | 1.13 | 5.30 | 1.50 | 1.47 | |
| 10.26 | 1.27 | 5.20 | 1.40 | 1.38 | |
| 10.40 | 1.40 | 5.10 | 1.30 | 1.28 | |
| 10.56 | 1.57 | 5.00 | 1.20 | 1.18 | |
| 10.78 | 1.78 | 4.90 | 1.10 | 1.09 | |
| 11.05 | 2.05 | 4.80 | 1.00 | 0.99 | |
| 11.40 | 2.40 | 4.70 | 0.90 | 0.89 | |
| 11.88 | 2.88 | 4.60 | 0.80 | 0.79 | |
| 12.38 | 3.38 | 4.50 | 0.70 | 0.69 | |
| 12.75 | 3.75 | 4.45 | 0.65 | 0.64 | |
| 13.20 | 4.20 | 4.40 | 0.60 | 0.60 | |
| 13.66 | 4.67 | 4.35 | 0.55 | 0.55 | |
| 14.28 | 5.28 | 4.30 | 0.50 | 0.50 | |
| 15.13 | 6.13 | 4.25 | 0.45 | 0.45 | |
| 16.05 | 7.05 | 4.20 | 0.40 | 0.40 | |
| 17.18 | 8.18 | 4.15 | 0.35 | 0.35 | |
| 18.51 | 9.52 | 4.10 | 0.30 | 0.30 | |
| 20.28 | 11.28 | 4.05 | 0.25 | 0.25 | |
| 22.65 | 13.65 | 4.00 | 0.20 | 0.20 | |
| 129.75 | 120.75 | 3.84 | 0.04 | 0.04 | |


ERT-24 DRAWDOWN
6.00
5.00
4.00
3.00
2.00
1.00
0.00
drawdown ft
1E-01
1E+00
1E+01
1E+02
time [min]
FILE: ERT24D.DAT

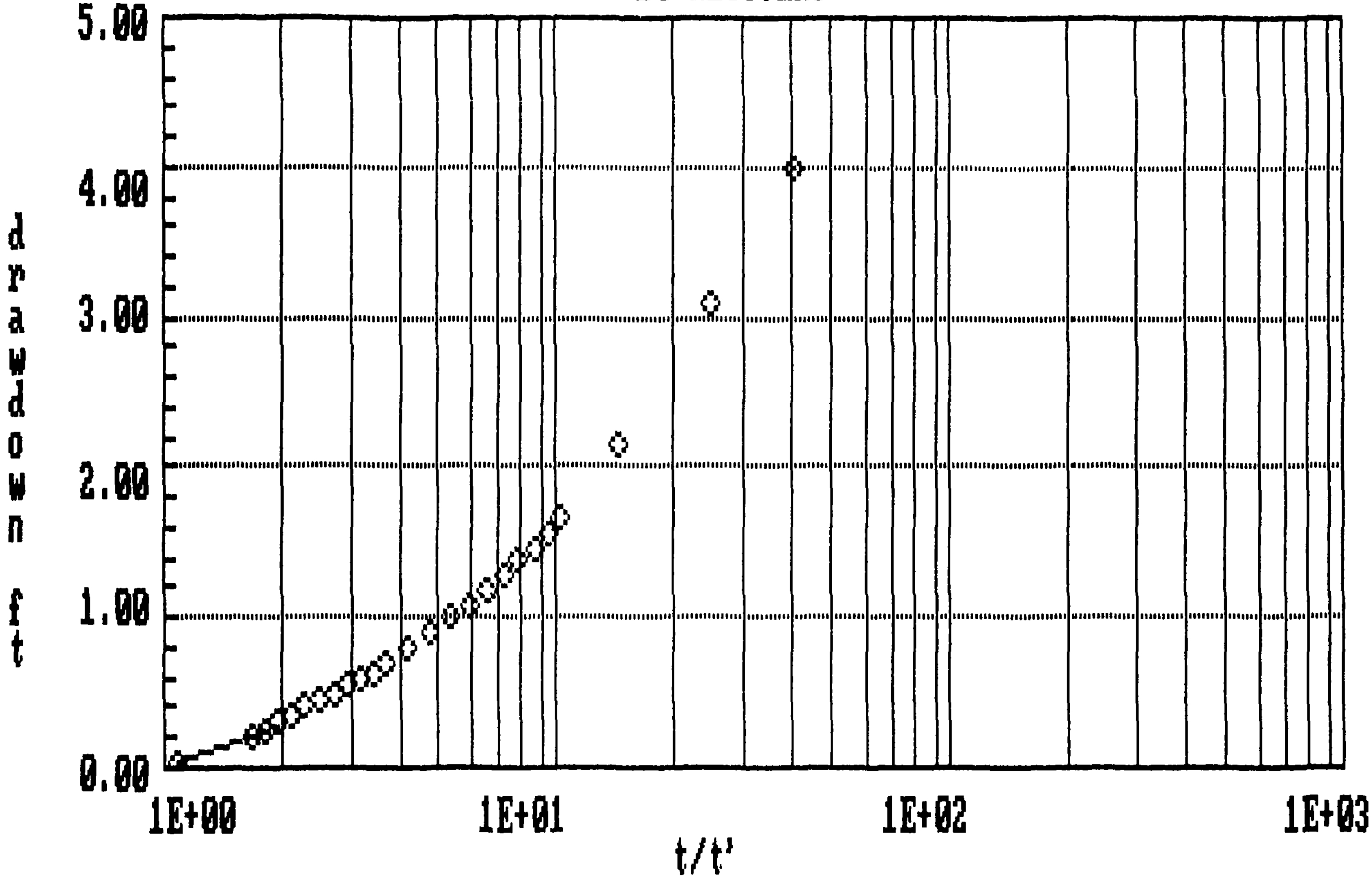


023711

023732

```
*********************************************************
*                                                       *
*              program:  JacobFit                       *
*              version:  IBM PC 1.0                     *
*                                                       *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S       *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.    *
*                                                       *
*********************************************************

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-24
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.    =  3.8 [ft]
DISCHARGE RATE...............  =  10.75 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]


NO      TIME [min]  DRAWDOWN [ft]      u        DEVIATION
--      ----------  -------------   --------    ---------
 1         0.71         3.990       .000E+00    +.000E+00
 2         1.71         4.880       .000E+00    +.000E+00
 3         3.31         5.310       .000E+00    +.000E+00
 4         3.63         5.400       .203E-04    -.168E-01
 5         4.11         5.490       .102E-04    -.452E-02
 6         4.73         5.570       .882E-05    +.478E-02
 7         5.66         5.660       .737E-05    +.447E-02
 8         6.78         5.740       .615E-05    -.637E-02
 9         7.98         5.830       .523E-05    +.164E-02


TRANSMISSIVITY T = .379E-02 [ft2/s]
               T =   2448 [gpd/ft]
STORATIVITY    S = .379E-04

DATA SEGMENT ANALYZED :
  - starting with data pair  5
  - ending   with data pair  9

DETERMINATION COEFFICENT = .9985399

******************************************************
```

ERT-24 RECOVERY




FILE: ERT24R.DAT



023733

```
*******************************************************
*                                                     *
*              program:  Recovery                     *
*              version:  IBM PC 1.0                   *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-24
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  3.8 [ft]
DISCHARGE RATE............... =  10.75 [gpm]
DURATION OF PUMPING PERIOD... =  9 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 0.23 | 9.23 | 40.13 | 3.990 | +.000E+00 |
| 2 | 0.38 | 9.38 | 24.68 | 3.080 | +.000E+00 |
| 3 | 0.67 | 9.67 | 14.43 | 2.140 | +.000E+00 |
| 4 | 0.97 | 9.97 | 10.28 | 1.670 | +.000E+00 |
| 5 | 1.05 | 10.05 | 9.57 | 1.570 | +.000E+00 |
| 6 | 1.13 | 10.13 | 8.96 | 1.470 | +.000E+00 |
| 7 | 1.27 | 10.27 | 8.09 | 1.380 | +.000E+00 |
| 8 | 1.40 | 10.40 | 7.43 | 1.280 | +.793E-01 |
| 9 | 1.57 | 10.57 | 6.73 | 1.180 | +.646E-01 |
| 10 | 1.78 | 10.78 | 6.06 | 1.090 | +.430E-01 |
| 11 | 2.05 | 11.05 | 5.39 | 0.990 | +.182E-01 |
| 12 | 2.40 | 11.40 | 4.75 | 0.890 | -.143E-03 |
| 13 | 2.88 | 11.88 | 4.13 | 0.790 | -.903E-02 |
| 14 | 3.38 | 12.38 | 3.66 | 0.690 | -.323E-01 |
| 15 | 3.75 | 12.75 | 3.40 | 0.640 | -.342E-01 |
| 16 | 4.20 | 13.20 | 3.14 | 0.600 | -.234E-01 |
| 17 | 4.67 | 13.67 | 2.93 | 0.550 | -.275E-01 |
| 18 | 5.28 | 14.28 | 2.70 | 0.500 | -.264E-01 |
| 19 | 6.13 | 15.13 | 2.47 | 0.450 | -.173E-01 |
| 20 | 7.05 | 16.05 | 2.28 | 0.400 | -.151E-01 |
| 21 | 8.18 | 17.18 | 2.10 | 0.350 | -.131E-01 |
| 22 | 9.52 | 18.52 | 1.95 | 0.300 | +.149E-01 |
| 23 | 11.28 | 20.28 | 1.80 | 0.250 | -.189E-02 |
| 24 | 13.65 | 22.65 | 1.66 | 0.200 | -.181E-01 |
| 25 | 120.75 | 129.75 | 1.07 | 0.040 | +.510E-02 |

TRANSMISSIVITY T = .452E-02 [ft2/s]
T = 2922 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair 22
- ending with data pair 25

DETERMINATION COEFFICENT = .9848253

*******************************************************

0237TT

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST: May 24, 1988

PUMPED WELL. ERT-25

OBSERVATION WELLS. ERT-25

CONTROL WELLS: none

BACKGROUND AND DESCRIPTION OF TEST:

Lithologic and completion logs and an illustration of the location of well ERT-25 precede the aquifer test data which follow Prior to purging the well, the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about two or three times per minute starting at 1 9 minutes into the test until the pump was shut off at 8 58 minutes after the start of pumping Recovery measurements were taken for over three hours following the test Because of the short duration of the test, only one flow measurement was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions.

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon.

INTERPRETATION:

Water level measurements were performed on the pumped well, ERT-25 The adjusted drawdown data from the pumped well were analyzed using the nonproprietary program JACOBFIT in the PUMPTEST package (Beljin, 1986) available from the International Ground Water Modeling Center. The program is based on the Cooper and Jacob (1946) approximation of the Theis equation. The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01.

where r is the radial distance between the pumped well and observation well (feet),
S is the storage coefficient (unitless)
T is the transmissivity ($ft^2$/day), and
t is the time since pumping started (days).

The parameter "u" is less than 0.01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line. The IGWMC program RECOVERY (Beljin, 1986) based upon the Theis (1935) recovery method was used to analyze the recovery data. The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate is 509 gpd/ft. using the drawdown data and 1554 gpd/ft using the recovery data The average hydraulic conductivity was determined to be 6 $0 \times 10^{-4}$ cm/sec. and $1.8 \times 10^{-3}$ cm/sec. respectively for the drawdown and recovery results The storage coefficient could not be determined from the single well test The results of this analysis are attached

The results of the recovery test are considered fair given that only two of the recovery data points were outside the significant influence of well bore storage Also the recovery response would be less sensitive to possible fluctuations in pumping rate The relatively poor comparison between the drawdown and recovery results is apparently due to the influence of well bore storage on the drawdown response Given that the relatively large drawdown in the pumped well, it is possible that the actual flows may have declined near the end of pumping Consequently, the measurement which was taken during the middle of the test may be somewhat higner that the average for the entire pumping period which would result in a slight overestimation of transmissivity

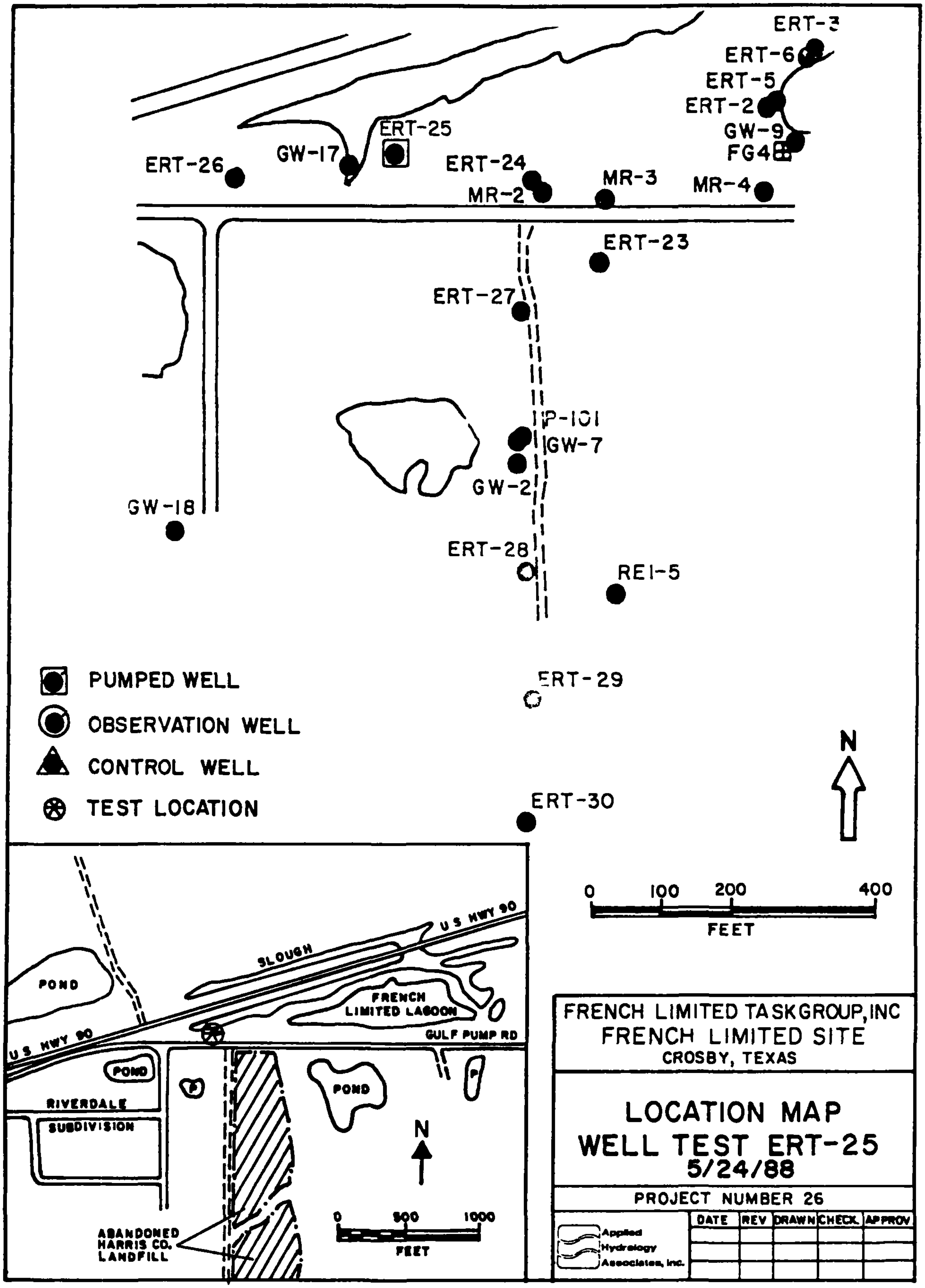
Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2.1 and shown below.

$$t_c > 0.6(16-1)/(11.76/31.56^*) - 24.2 \text{ minutes}$$

* drawdown at end of pumping rather than at time $t_c$ which is beyond the end of pumping

Consequently, the drawdown data for the entire test should not be used for interpretation. Likewise, since $t_c$ is greater than 24.2 minutes, only the last two recovery data points are in the range where well bore influences are minimal.

0237.3


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
ERT-26
GW-17
ERT-24
MR-3
MR-2
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE
SUBDIVISION
P
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-25
5/24/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK.
APPROV
Applied Hydrology Associates, Inc.

ERT 02378

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

# BORING LOG AND CONSTRUCTION OF ERT- 25

Client: Alco Chemical
Project Name: Sikes/Crosby, Ltd. Site
Project Location: Crosby, TX
Job No.: [illegible]  Boring No.: ERT-25
Logged By: C. Teller
Approved By:
Drilled By: Southwestern Labs  Driller's Name: Tony Sandoval

**DRILLING AND SAMPLING INFORMATION**

Date Started: 3-29-88  Date Completed: 3-29-88
Method: Mud rotary  Total Depth: 53 ft

**WELL COMPLETION INFORMATION**

Screen Dia.: 4 in  Length: 40 ft
Slot Size: 0.010 in  Type: PVC
Casing Dia.: 4 in  Length: ~~[illegible]~~ 8 ft.

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Medium dense brown silty fine sand, little to some clay. Occasional roots, organic fragments. (SM-SP) | J-1 | SS | 1.5 | | 3-5-4 | | (0.3) 0.3 | | * |
| 5 | -5' tan, trace silt, no clay, no organic debris | J-2 | SS | 5.0 | | 3-7-9 | | 0.3 | | |
| 10 | -10' dense, fine to medium | J-3 | SS | 10.0 | | 9-12-27 | | [illegible] | | |
| 15 | -15' tan and gray, occasional ½" clayey seams. | J-4 | SS | 15.0 | | 8-16-19 | | [illegible] | | |
| 20 | -20' fine to medium, some coarse, occasional ½" clay seams. (23.0') | J-5 | SS | 20.0 | | 6-31/6" | | [illegible] | | |
| 25 | Stiff gray, tan, and reddish brown silty clay, occasional black streaks. (CL) | J-6 | SS | 25.0 | 3.0 | 4-6-7 | | [illegible] | | |
| 30 | -30' mostly gray (33.0') | J-7 | SS | 30.0 | 3.5 | 5-8-9 | | 0.5 | | |
| 35 | Stiff/medium dense gray with red and yellow streaks, clayey silt (MH) | J-8 | SS | 35.0 | | 6-13-24 | | 0.5 | | |
| 40 | -40' some dark yellow patches, decreased amount of clay, occasional clayey seams 1" thick | J-9 | ST | 40.0 | | | | 0.5 | | |
| 45 | -45' 1" fine sand seams, little to some fine sand throughout. (47.0') | J-10 | ST | 45.0 | | | | 0.5 | | |
| 50 | Very stiff reddish brown with gray and yellow streaks silty clay to clay, with silt partings and calcareous nodules; slickensided. (CH-CL) (53.0') | J-11 | ST | 50.0 | 4.25 | | | 0.5 | | |
| 55 | Boring terminates at 53 ft. | | | | | | | | | |

* Background readings in parentheses

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

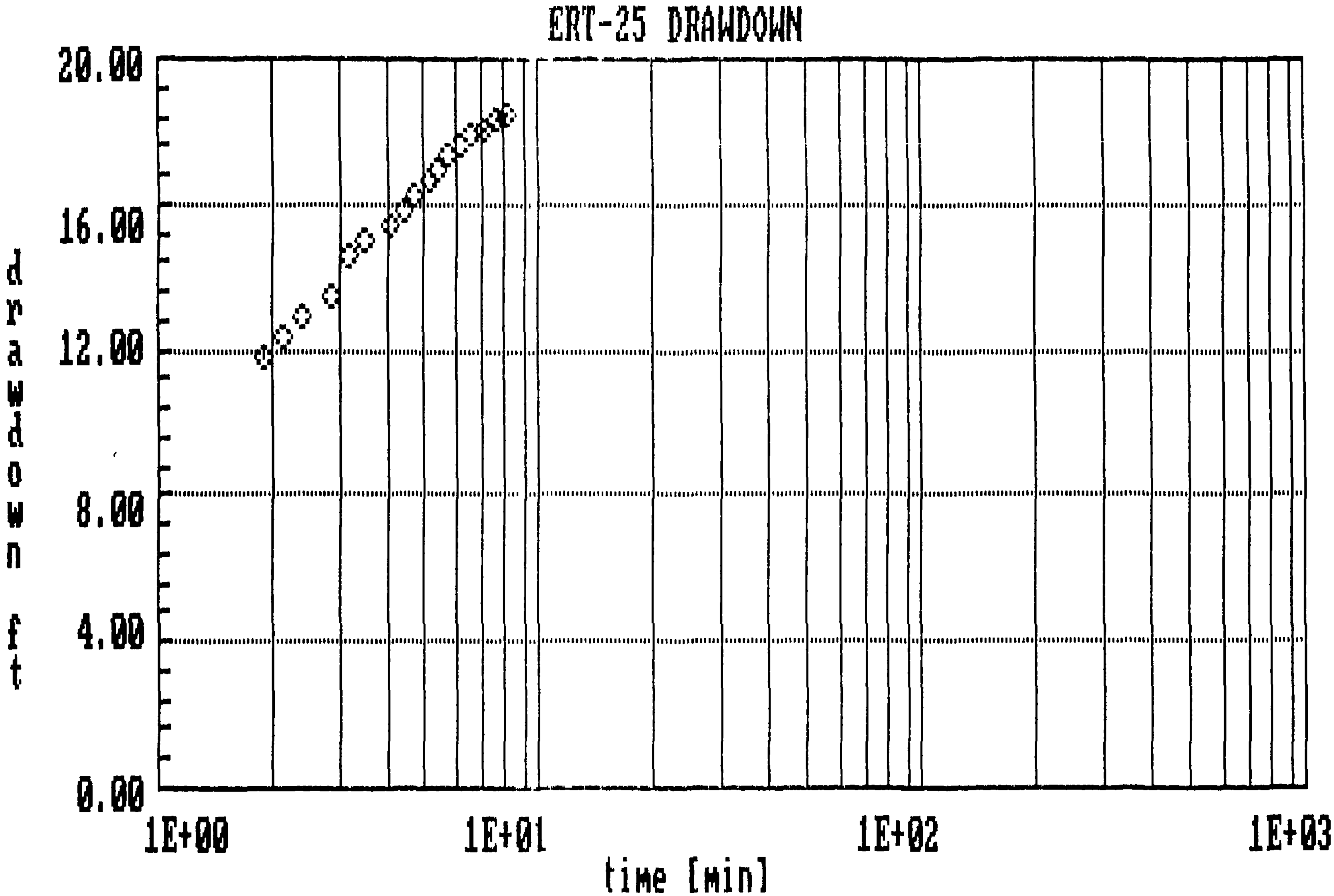
FRENCH LIMITED
CROSBY, TX
WELL ERT-25

DATE: 5/24/88
STATIC WATER LEVEL: 6.44 FEET
PUMPING RATE: 11.76 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 44.55 FEET (SOUNDED)
AQUIFER THICKNESS: 44.55 - 6.44 = 38.11 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 1.90 | | 21.00 | 14.56 | 11.78 | |
| 2.13 | | 22.00 | 15.56 | 12.38 | |
| 2.38 | | 23.00 | 16.56 | 12.96 | |
| 2.85 | | 24.00 | 17.56 | 13.51 | |
| 3.17 | | 26.00 | 19.56 | 14.54 | |
| 3.45 | | 27.00 | 20.56 | 15.01 | |
| 4.03 | | 28.00 | 21.56 | 15.46 | |
| 4.40 | | 29.00 | 22.56 | 15.88 | 5 gal/25.5 sec |
| 4.73 | | 30.00 | 23.56 | 16.28 | |
| 5.18 | | 31.00 | 24.56 | 16.65 | |
| 5.48 | | 32.00 | 25.56 | 16.99 | |
| 5.85 | | 33.00 | 26.56 | 17.30 | |
| 6.32 | | 34.00 | 27.56 | 17.59 | |
| 6.75 | | 35.00 | 28.56 | 17.86 | |
| 7.25 | | 36.00 | 29.56 | 18.10 | |
| 7.80 | | 37.00 | 30.56 | 18.31 | |
| 8.40 | | 38.00 | 31.56 | 18.49 | |
| 8.58 | | | | | Pump Off |
| 9.67 | 1.08 | 26.00 | 19.56 | 14.54 | |
| 9.77 | 1.18 | 25.00 | 18.56 | 14.04 | |
| 9.83 | 1.25 | 24.00 | 17.56 | 13.51 | |
| 9.93 | 1.35 | 23.00 | 16.56 | 12.96 | |
| 10.02 | 1.43 | 22.00 | 15.56 | 12.38 | |
| 10.12 | 1.53 | 21.00 | 14.56 | 11.78 | |
| 10.22 | 1.63 | 20.00 | 13.56 | 11.15 | |
| 10.32 | 1.73 | 19.00 | 12.56 | 10.49 | |
| 10.43 | 1.85 | 18.00 | 11.56 | 9.81 | |
| 10.50 | 1.92 | 17.50 | 11.06 | 9.46 | |
| 10.57 | 1.98 | 17.00 | 10.56 | 9.10 | |
| 10.63 | 2.05 | 16.50 | 10.06 | 8.73 | |
| 10.70 | 2.12 | 16.00 | 9.56 | 8.36 | |
| 10.77 | 2.18 | 15.50 | 9.06 | 7.98 | |
| 10.83 | 2.25 | 15.00 | 8.56 | 7.60 | |
| 10.92 | 2.33 | 14.50 | 8.06 | 7.21 | |
| 11.00 | 2.42 | 14.00 | 7.56 | 6.81 | |
| 11.08 | 2.50 | 13.50 | 7.06 | 6.41 | |
| 11.17 | 2.58 | 13.00 | 6.56 | 6.00 | |
| 11.28 | 2.70 | 12.50 | 6.06 | 5.58 | |

ERT-25 PAGE 2

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 11.38 | 2.80 | 12.00 | 5.56 | 5.15 | |
| 11.50 | 2.92 | 11.50 | 5.06 | 4.72 | |
| 11.62 | 3.03 | 11.00 | 4.56 | 4.29 | |
| 11.75 | 3.17 | 10.50 | 4.06 | 3.84 | |
| 11.92 | 3.33 | 10.00 | 3.56 | 3.39 | |
| 12.13 | 3.55 | 9.50 | 3.06 | 2.94 | |
| 12.40 | 3.82 | 9.00 | 2.56 | 2.47 | |
| 12.82 | 4.23 | 8.50 | 2.06 | 2.00 | |
| 13.50 | 4.92 | 8.00 | 1.56 | 1.53 | |
| 14.95 | 6.37 | 7.50 | 1.06 | 1.05 | |
| 19.82 | 11.23 | 7.00 | 0.56 | 0.56 | |
| 22.58 | 14.00 | 6.90 | 0.46 | 0.46 | |
| 24.42 | 15.83 | 6.85 | 0.41 | 0.41 | |
| 26.10 | 17.52 | 6.80 | 0.36 | 0.36 | |
| 44.38 | 35.80 | 6.64 | 0.20 | 0.20 | |
| 182.98 | 174.40 | 6.55 | 0.11 | 0.11 | |




FILE: ERT25D.DAT



023741

```
*********************************************************
*                                                       *
*              program:  JacobFit                       *
*              version:  IBM PC 1.0                     *
*                                                       *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S       *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.    *
*                                                       *
*********************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-25
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  6.44 [ft]
DISCHARGE RATE............... =  11.76 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]

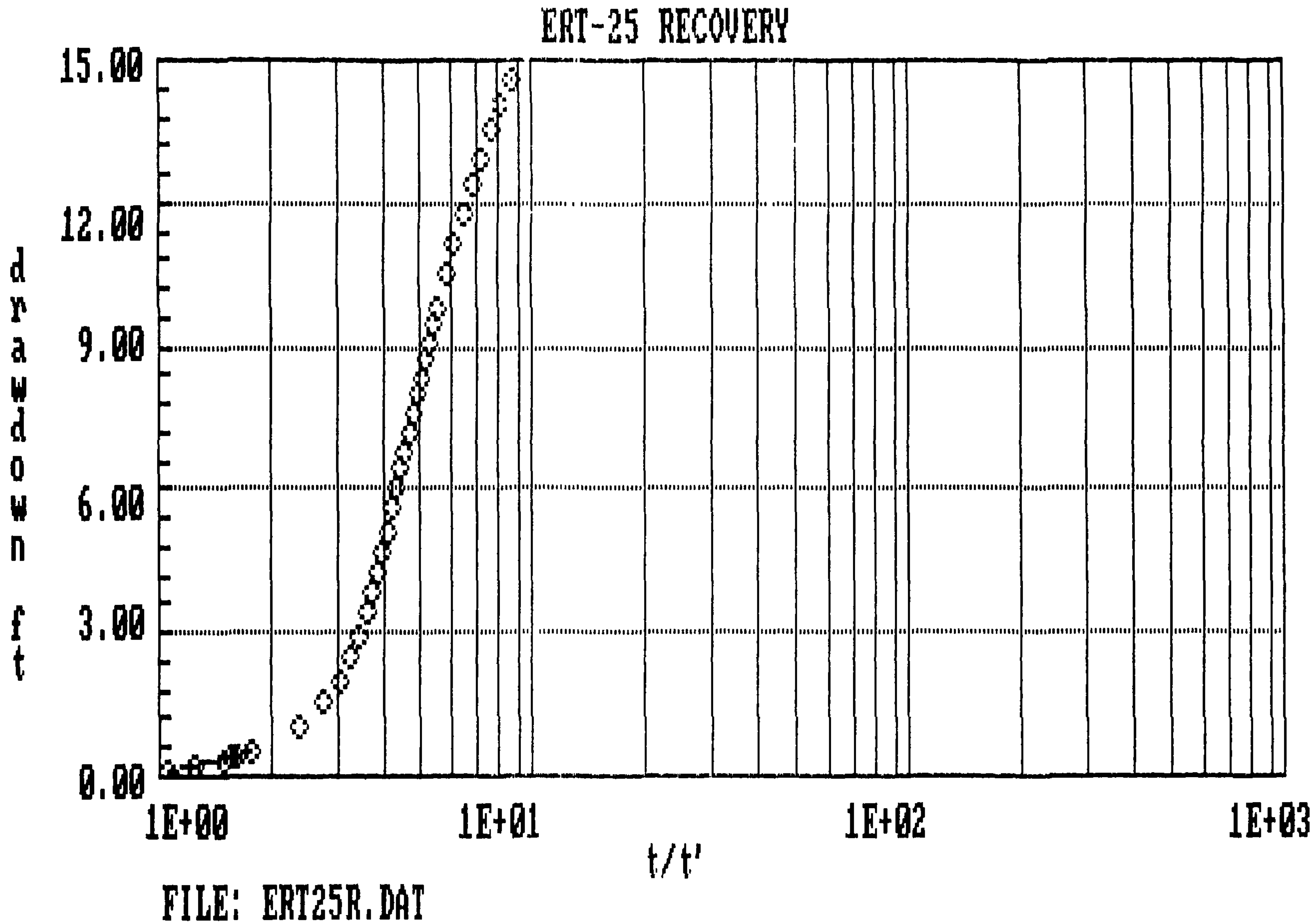
| NO | TIME [min] | DRAWDOWN [ft] | u | DEVIATION |
|---|---|---|---|---|
| 1 | 1.90 | 11.780 | .000E+00 | +.000E+00 |
| 2 | 2.13 | 12.380 | .000E+00 | +.000E+00 |
| 3 | 2.38 | 12.960 | .000E+00 | +.000E+00 |
| 4 | 2.85 | 13.510 | .000E+00 | +.000E+00 |
| 5 | 3.17 | 14.540 | .000E+00 | +.000E+00 |
| 6 | 3.45 | 15.010 | .000E+00 | +.000E+00 |
| 7 | 4.03 | 15.460 | .000E+00 | +.000E+00 |
| 8 | 4.40 | 15.880 | .000E+00 | +.000E+00 |
| 9 | 4.73 | 16.280 | .000E+00 | +.000E+00 |
| 10 | 5.13 | 16.650 | .000E+00 | +.000E+00 |
| 11 | 5.48 | 16.990 | .000E+00 | +.000E+00 |
| 12 | 5.85 | 17.300 | .000E+00 | +.000E+00 |
| 13 | 6.32 | 17.590 | .000E+00 | +.000E+00 |
| 14 | 6.75 | 17.860 | .113E-02 | -.171E-01 |
| 15 | 7.25 | 18.100 | .603E-03 | -.549E-02 |
| 16 | 7.80 | 18.310 | .560E-03 | +.109E-01 |
| 17 | 8.40 | 18.490 | .520E-03 | -.538E-02 |

TRANSMISSIVITY T = .787E-03 [ft2/s]
               T =    509 [gpd/ft]
STORATIVITY    S = .826E-03

DATA SEGMENT ANALYZED :
- starting with data pair 15
- ending with data pair 17

DETERMINATION COEFFICENT = .9980304

*******************************************************


ERT-25 RECOVERY
15.00
12.00
9.00
6.00
3.00
0.00
drawdown ft
1E+00
1E+01
1E+02
1E+03
t/t'
FILE: ERT25R.DAT

B-102

023743

023741

```
*************************************************************
*                                                           *
*              program:  Recovery                           *
*              version:  IBM PC 1.0                         *
*                                                           *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S           *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.        *
*                                                           *
*************************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-25
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  6.44 [ft]
DISCHARGE RATE.............. =  11.76 [gpm]
DURATION OF PUMPING PERIOD... =  8.58 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 1.08 | 9.66 | 8.94 | 14.540 | +.000E+00 |
| 2 | 1.18 | 9.76 | 8.27 | 14.040 | +.000E+00 |
| 3 | 1.25 | 9.83 | 7.86 | 13.510 | +.000E+00 |
| 4 | 1.35 | 9.93 | 7.36 | 12.960 | +.000E+00 |
| 5 | 1.43 | 10.01 | 7.00 | 12.380 | +.000E+00 |
| 6 | 1.53 | 10.11 | 6.61 | 11.780 | +.000E+00 |
| 7 | 1.63 | 10.21 | 6.26 | 11.150 | +.000E+00 |
| 8 | 1.73 | 10.31 | 5.96 | 10.490 | +.000E+00 |
| 9 | 1.85 | 10.43 | 5.64 | 9.810 | +.000E+00 |
| 10 | 1.92 | 10.50 | 5.47 | 9.460 | +.000E+00 |
| 11 | 1.98 | 10.56 | 5.33 | 9.100 | +.000E+00 |
| 12 | 2.05 | 10.63 | 5.19 | 8.730 | +.000E+00 |
| 13 | 2.12 | 10.70 | 5.05 | 8.360 | +.000E+00 |
| 14 | 2.18 | 10.76 | 4.94 | 7.980 | +.000E+00 |
| 15 | 2.25 | 10.83 | 4.81 | 7.600 | +.000E+00 |
| 16 | 2.33 | 10.91 | 4.68 | 7.210 | +.000E+00 |
| 17 | 2.42 | 11.00 | 4.55 | 6.810 | +.000E+00 |
| 18 | 2.50 | 11.08 | 4.43 | 6.410 | +.000E+00 |
| 19 | 2.58 | 11.16 | 4.33 | 6.000 | +.000E+00 |
| 20 | 2.70 | 11.28 | 4.18 | 5.580 | +.000E+00 |
| 21 | 2.80 | 11.38 | 4.06 | 5.150 | +.000E+00 |
| 22 | 2.92 | 11.50 | 3.94 | 4.720 | +.000E+00 |
| 23 | 3.03 | 11.61 | 3.83 | 4.290 | +.000E+00 |
| 24 | 3.17 | 11.75 | 3.71 | 3.840 | +.000E+00 |
| 25 | 3.33 | 11.91 | 3.58 | 3.390 | +.000E+00 |
| 26 | 3.55 | 12.13 | 3.42 | 2.940 | +.000E+00 |
| 27 | 3.82 | 12.40 | 3.25 | 2.470 | +.000E+00 |
| 28 | 4.23 | 12.81 | 3.03 | 2.000 | +.000E+00 |
| 29 | 4.92 | 13.50 | 2.74 | 1.530 | +.000E+00 |
| 30 | 6.37 | 14.95 | 2.35 | 1.050 | +.107E+00 |
| 31 | 11.23 | 19.81 | 1.76 | 0.560 | +.271E-01 |
| 32 | 14.00 | 22.58 | 1.61 | 0.460 | +.479E-02 |
| 33 | 15.83 | 24.41 | 1.54 | 0.410 | -.625E-02 |
| 34 | 17.52 | 26.10 | 1.49 | 0.360 | -.263E-01 |
| 35 | 35.80 | 44.38 | 1.24 | 0.200 | -.270E-01 |
| 36 | 174.40 | 182.98 | 1.05 | 0.110 | +.277E-01 |

TRANSMISSIVITY T = .240E-02 [ft2/s]
T =    1554 [gpd/ft]

DATA SEGMENT ANALYZED :

- ending with data pair 36

DETERMINATION COEFFICENT = .9786831

*******************************************************

023746

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST: May 24, 1988

PUMPED WELL ERT-26

OBSERVATION WELLS ERT-26

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-26 precede the aquifer test data which follow Prior to purging the well the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about one to three times per minute until the pump was shut off at 8 1 minutes after the start of pumping Recovery measurements were taken for almost 3 5 hours following the test Because of the short duration of the test, only one flow measurement was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

INTERPRETATION·

Water level measurements were performed on the pumped well, ERT-26 The adjusted drawdown data from the pumped well were analyzed using the nonproprietary program JACOBFIT contained in the PUMPTEST package (Beljin, 1986) available from the International Ground Water Modeling Center The program is based on the Cooper and Jacob (1946) approximation of the Theis equation The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where r is the radial distance between the pumped well and observation well (feet),
S is the storage coefficient (unitless)
T is the transmissivity ($ft^2$/day), and
t is the time since pumping started (days)

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line The program RECOVERY (Beljin, 1986) based upon the Theis (1935) recovery method was used to analyze the recovery data The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate is 364 gpd/ft using the drawdown data and 1264 gpd/ft using the recovery data The average hydraulic conductivity was determined to be 4 $3x10^{-4}$ cm/sec and 1 $5x10^{-3}$ cm/sec respectively for the drawdown and recovery results The storage coefficient could not be determined from the single well test The results of this analysis are attached

The results of the recovery test are considered fair given that only two of the recovery data points were outside the significant influence of well bore storage The relatively poor comparison between the drawdown and recovery results is apparently due to the influence of well bore storage on the drawdown response Also the recovery response would be less sensitive to possible fluctuations in pumping rate Given that the relatively large drawdown in the pumped well, it is possible that the actual flows may have declined near the end of pumping Consequently, the measurement which was taken during the middle of the test may be somewhat higher that the average for the entire pumping period which would result in a slight overestimation of transmissivity

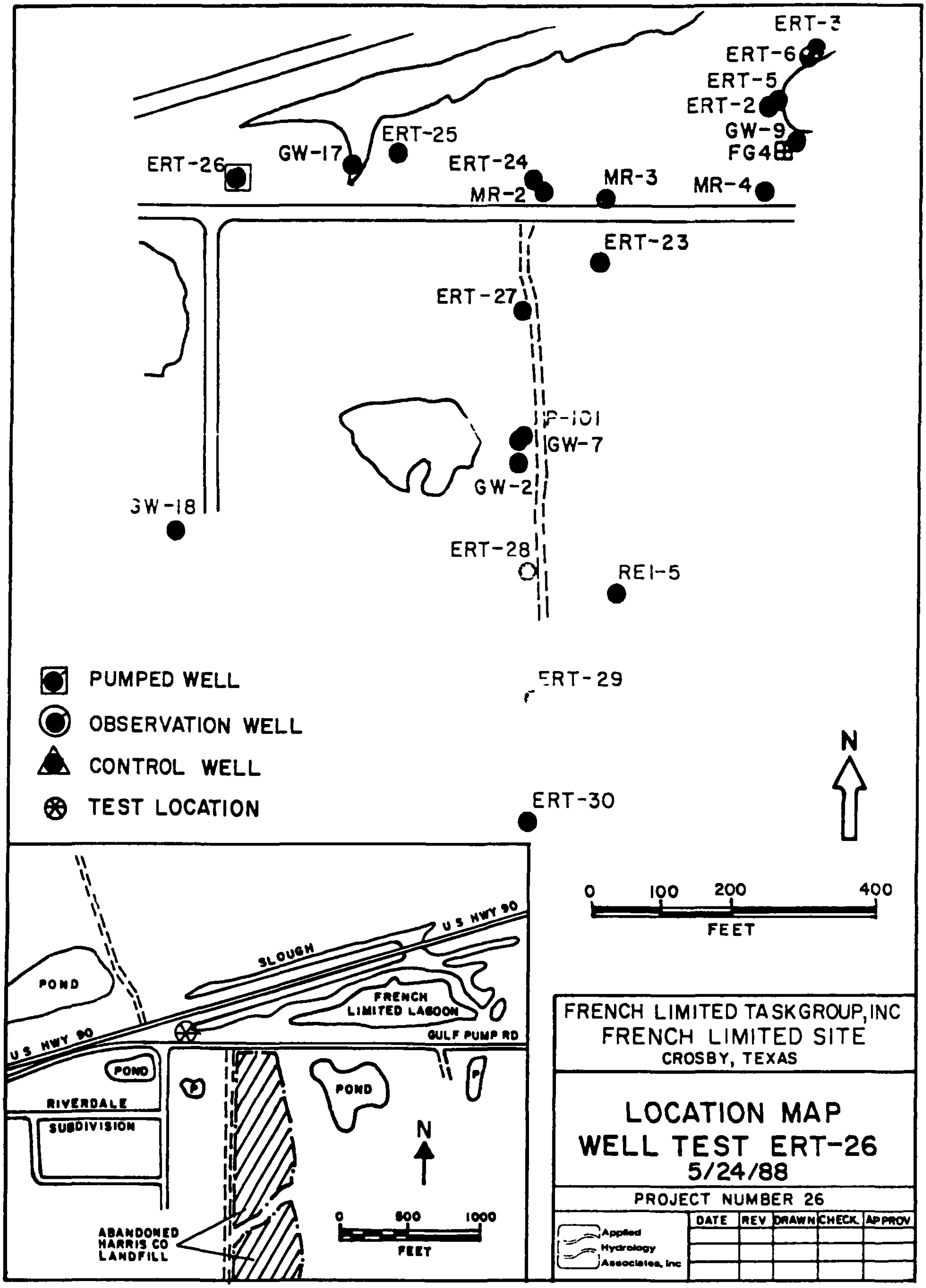
Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2 1 and shown below

$t_c$ > 0.6(16-1)/(11 54/21 55*) = 16 8 minutes

* drawdown at end of pumping rather than at time $t_c$ which is beyond the end of pumping

Consequently, the drawdown data for the entire test should not be used for interpretation. Likewise, since tc is greater than 16 8 minutes, only the last two recovery data points are in the range where well bore influences are minimal

023748


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-2
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
POND
RIVERDALE SUBDIVISION
POND
N
0 500 1000
FEET
ABANDONED HARRIS CO LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-26
5/24/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc
DATE
REV
DRAWN
CHECK
APPROV

022 **ERT**

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-26

Client: ARCO CHEMICAL
Project Name: FRENCH, LTD SITE
Project Location: CROSBY, TX
Job No.: [illegible]
Boring No.: ERT-26
Logged By: C. TELLER
Approved By:
Drilled By: SOUTHWESTERN LABS
Driller's Name: TOM SANDOVAL

**DRILLING AND SAMPLING INFORMATION**

Date Started: 3-30-88
Date Completed: 3-30-88
Method: Mud Rotary
Total Depth: 56 ft

**WELL COMPLETION INFORMATION**

Screen Dia.: 4 in
Length: 40 ft
Slot Size: 0.010 in
Type: PVC
Casing Dia.: 4 in
Length: 8 ft

SURFACE ELEVATION

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Loose tan fine sand, rock fill at surface. (SW-SC) | J-1 | SS | 1.5 | | 3-6-6 | | [illegible] | | |
| 5 | -5' little fine shell fragments | J-2 | SS | 5.0 | | 4-5-6 | | 0.1 | | |
| 10 | -10' silty, some clay | J-3 | SS | 10.0 | | 4-4-13 | | [illegible] | | |
| 15 | (17.0') | | | | | | | | | |
| 20 | Very stiff, reddish brown with gray mottling, clay, occasional black streaks (CH) | J-4 | SS | 20.0 | 4.5 | [illegible]-13-18 | | [illegible] | | |
| 25 | | J-5 | SS | 25.0 | 4.5 | 5-14-24 | | [illegible] | | |
| 30 | -32' drills like sand, 6" layer. (35.0') | J-6 | SS | [illegible] | 4.5 | [illegible]-17-27 | | [illegible] | | |
| 35 | Stiff/dense gray with yellow streaks, clayey silt (MH)<br>-36' sandy layer 1.5' thick felt by driller | J-7 | ST | 36.0 | | | | [illegible] | | |
| 40 | -40' little clay<br>-43' drills like sand, thin layer | J-8 | ST | 41.0 | | | | [illegible] | | |
| 45 | -45' occasional dark yellow patches | J-9 | ST | 46.0 | | | | [illegible] | | |
| 50 | -50' 1" fine sand seams, some fine sand throughout. (51.5')<br>Stiff reddish brown with gray streaks clay (CH) (54.5') | J-10 | ST | 51.0 | | | | [illegible] | | |
| 55 | Dense tan silty fine to coarse sand (SM) (56.0') | J-11 | ST | 56.0 | | | | 0.0 | | |

Boring terminated at 56 ft.
* Background readings in parentheses
Surface casing (pvc) driven to 8 ft depth

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

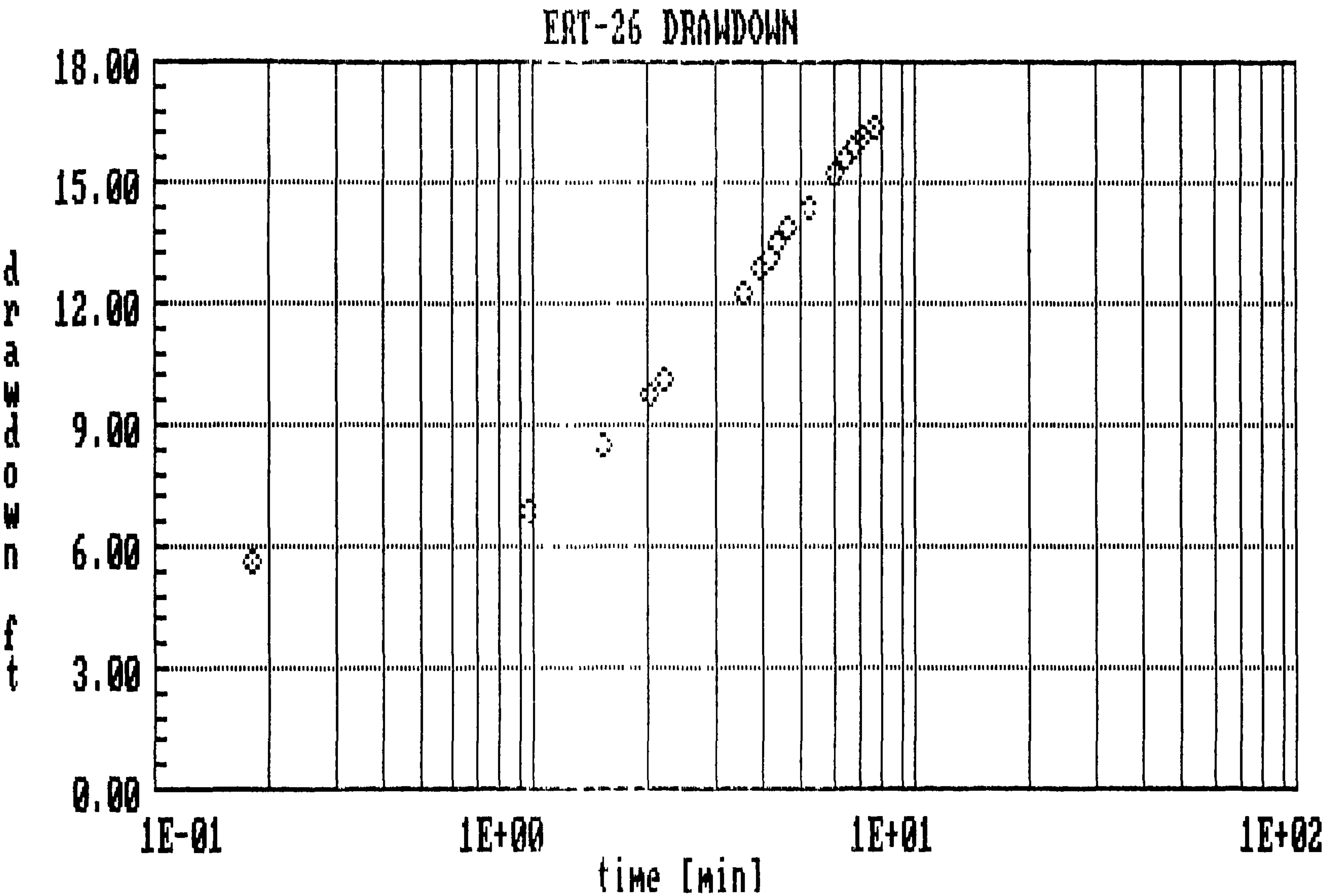
**BORING METHOD**
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023750

FRENCH LIMITED
CROSBY, TX
WELL ERT-26

DATE: 5/24/88
STATIC WATER LEVEL: 4.45 FEET
PUMPING RATE: 11.54 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 49.4 FEET (SOUNDED)
AQUIFER THICKNESS: 49.4 - 4.45 = 44.95 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 0.18 | | 10.43 | 5.98 | 5.58 | |
| 0.98 | | 12.00 | 7.55 | 6.92 | |
| 1.52 | | 14.00 | 9.55 | 8.54 | |
| 2.02 | | 15.50 | 11.05 | 9.69 | |
| 2.20 | | 16.00 | 11.55 | 10.07 | |
| 3.57 | | 19.00 | 14.55 | 12.20 | 5 gal/26 sec |
| 3.93 | | 20.00 | 15.55 | 12.86 | |
| 4.17 | | 20.50 | 16.05 | 13.18 | |
| 4.35 | | 21.00 | 16.55 | 13.50 | |
| 4.63 | | 21.50 | 17.05 | 13.82 | |
| 5.27 | | 22.50 | 18.05 | 14.43 | |
| 6.18 | | 19.55 | 15.30 | 15.30 | |
| 6.52 | | 24.50 | 20.05 | 15.58 | |
| 6.93 | | 25.00 | 20.55 | 15.85 | |
| 7.28 | | 25.50 | 21.05 | 16.12 | |
| 7.82 | | 26.00 | 21.55 | 16.38 | |
| 8.10 | | | | | Pump Off |
| 9.52 | 1.42 | 11.00 | 6.55 | 6.07 | |
| 9.68 | 1.58 | 10.00 | 5.55 | 5.21 | |
| 9.90 | 1.80 | 9.00 | 4.55 | 4.32 | |
| 10.07 | 1.97 | 8.50 | 4.05 | 3.87 | |
| 10.25 | 2.15 | 8.00 | 3.55 | 3.41 | |
| 10.50 | 2.40 | 7.50 | 3.05 | 2.95 | |
| 10.70 | 2.60 | 7.00 | 2.55 | 2.48 | |
| 11.08 | 2.98 | 6.75 | 2.30 | 2.24 | |
| 11.40 | 3.30 | 6.50 | 2.05 | 2.00 | |
| 11.78 | 3.68 | 6.25 | 1.80 | 1.76 | |
| 12.33 | 4.23 | 6.00 | 1.55 | 1.52 | |
| 13.02 | 4.92 | 5.80 | 1.35 | 1.33 | |
| 13.90 | 5.80 | 5.60 | 1.15 | 1.14 | |
| 14.52 | 6.42 | 5.50 | 1.05 | 1.04 | |
| 15.35 | 7.25 | 5.40 | 0.95 | 0.94 | |
| 16.42 | 8.32 | 5.30 | 0.85 | 0.84 | |
| 17.72 | 9.62 | 5.20 | 0.75 | 0.74 | |
| 19.48 | 11.38 | 5.10 | 0.65 | 0.65 | |
| 80.63 | 72.53 | 4.65 | 0.20 | 0.20 | |
| 216.77 | 208.67 | 4.59 | 0.14 | 0.14 | |




FILE: ERT26D.DAT

B-110

023751

023752

```
*******************************************************
*                                                     *
*             program:  JacobFit                      *
*             version:  IBM PC 1.0                    *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-26
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  4.45 [ft]
DISCHARGE RATE............... =  11.54 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]

| NO | TIME [min] | DRAWDOWN [ft] | u | DEVIATION |
|---|---|---|---|---|
| 1 | 0.18 | 5.580 | .000E+00 | +.000E+00 |
| 2 | 0.98 | 6.920 | .000E+00 | +.000E+00 |
| 3 | 1.52 | 8.540 | .000E+00 | +.000E+00 |
| 4 | 2.02 | 9.690 | .000E+00 | +.000E+00 |
| 5 | 2.20 | 10.070 | .000E+00 | +.000E+00 |
| 6 | 3.57 | 12.200 | .000E+00 | +.000E+00 |
| 7 | 3.93 | 12.860 | .000E+00 | +.000E+00 |
| 8 | 4.17 | 13.180 | .418E-01 | -.743E-01 |
| 9 | 4.35 | 13.500 | .400E-01 | +.301E-01 |
| 10 | 4.63 | 13.820 | .376E-01 | +.319E-01 |
| 11 | 5.27 | 14.430 | .331E-01 | -.186E-01 |
| 12 | 6.18 | 15.300 | .282E-01 | +.389E-01 |
| 13 | 6.52 | 15.580 | .267E-01 | +.457E-01 |
| 14 | 6.93 | 15.850 | .251E-01 | +.464E-02 |
| 15 | 7.28 | 16.120 | .667E-02 | +.973E-04 |
| 16 | 7.82 | 16.380 | .621E-02 | -.992E-04 |

TRANSMISSIVITY T = .563E-03 [ft2/s]
               T =    364 [gpd/ft]
STORATIVITY    S = .656E-02

DATA SEGMENT ANALYZED :
  - starting with data pair  15
  - ending   with data pair  16

DETERMINATION COEFFICENT = 1.000985

*******************************************************

023753

```
*******************************************************
*                                                     *
*              program:  Recovery                     *
*              version:  IBM PC 1.0                   *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-26
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  4.45 [ft]
DISCHARGE RATE............... =  11.54 [gpm]
DURATION OF PUMPING PERIOD... =  8.1 [min]

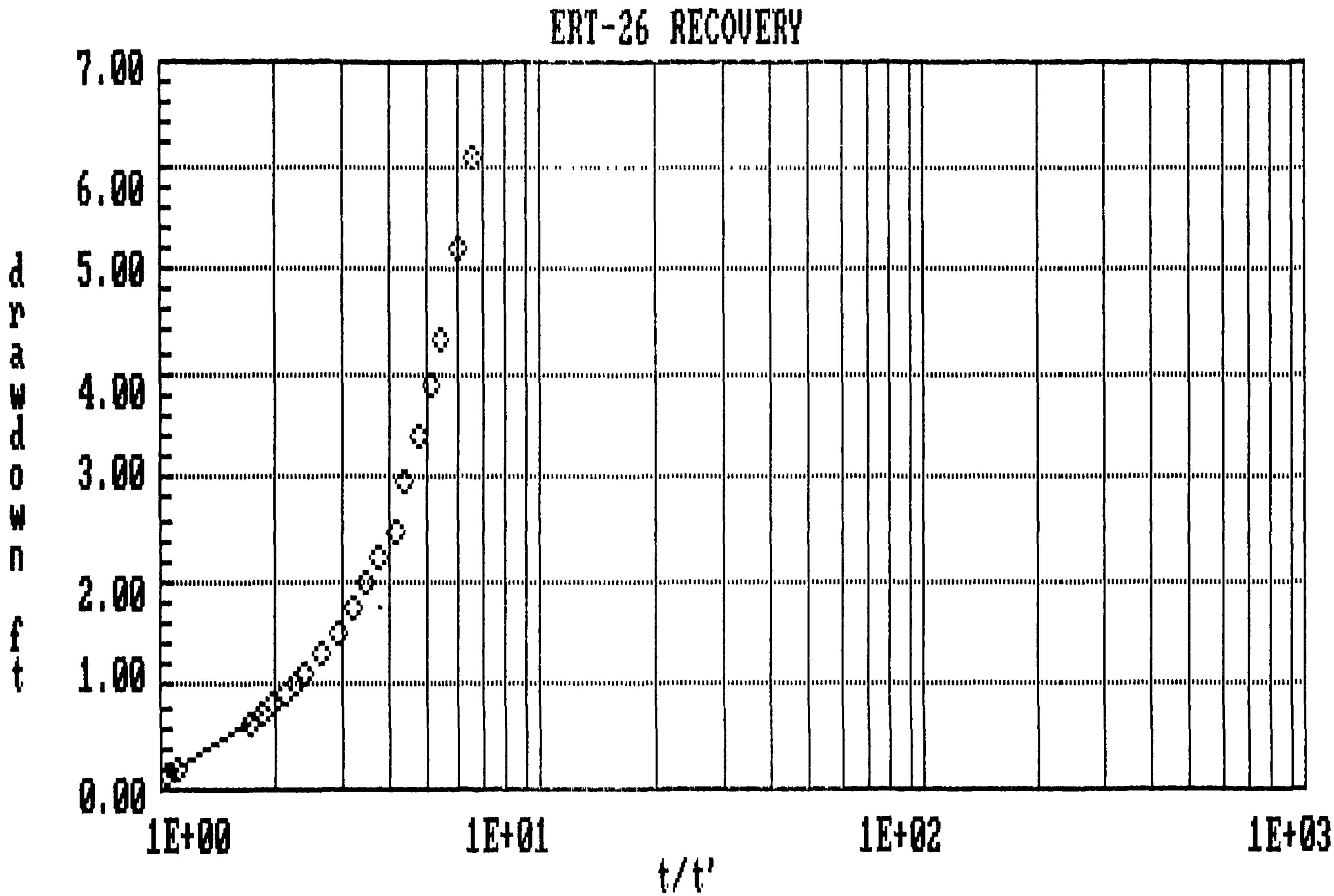
| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 1.42 | 9.52 | 6.70 | 6.070 | +.155E+01 |
| 2 | 1.58 | 9.68 | 6.13 | 5.210 | +.955E+00 |
| 3 | 1.80 | 9.90 | 5.50 | 4.320 | +.378E+00 |
| 4 | 1.97 | 10.07 | 5.11 | 3.670 | +.140E+00 |
| 5 | 2.15 | 10.25 | 4.77 | 3.410 | -.118E+00 |
| 6 | 2.40 | 10.50 | 4.38 | 2.950 | -.329E+00 |
| 7 | 2.60 | 10.70 | 4.12 | 2.480 | -.622E+00 |
| 8 | 2.98 | 11.08 | 3.72 | 2.240 | -.567E+00 |
| 9 | 3.30 | 11.40 | 3.45 | 2.000 | -.594E+00 |
| 10 | 3.68 | 11.78 | 3.20 | 1.760 | -.613E+00 |
| 11 | 4.23 | 12.33 | 2.91 | 1.520 | -.582E+00 |
| 12 | 4.92 | 13.02 | 2.65 | 1.330 | -.492E+00 |
| 13 | 5.80 | 13.90 | 2.40 | 1.140 | [illegible] |
| 14 | 6.42 | 14.52 | 2.26 | 1.040 | [illegible] |
| 15 | 7.25 | 15.35 | 2.12 | 0.940 | +.285E-01 |
| 16 | 8.32 | 16.42 | 1.97 | 0.840 | +.594E-02 |
| 17 | 9.62 | 17.72 | 1.84 | 0.740 | +.654E-02 |
| 18 | 11.38 | 19.48 | 1.71 | 0.650 | -.678E-02 |
| 19 | 72.53 | 80.63 | 1.11 | 0.200 | -.533E-02 |
| 20 | 208.67 | 216.77 | 1.04 | 0.140 | +.557E-02 |

TRANSMISSIVITY T = .196E-02 [ft2/s]
T =   1264 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair  17
- ending   with data pair  20

DETERMINATION COEFFICENT = .9994734

*******************************************************




FILE: ERT26R.DAT

023755

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 24, 1988

PUMPED WELL ERT-27

OBSERVATION WELLS ERT-27

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-27 precede the aquifer test data which follow Prior to purging the well the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about one time per minute starting at 4 4 minutes into the test until the pump was shut off at 7 23 minutes after the start of pumping Recovery measurements were taken for about 1 5 hours following the test Because of the short duration of the test, only one flow measurements was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

INTERPRETATION

Water level measurements were performed on the pumped well, ERT-27 Because of the short pumping time, only the recovery data were analyzed This was done via use of the RECOVERY program in the nonproprietary PUMPTEST package (Beljin, 1986) which is based on the Theis (1935) recovery method and available from the International Ground Water Modeling Center The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate from the recovery data is 7001 gpd/ft The average hydraulic conductivity was determined to be 8 3x10$^{-3}$ cm/sec The storage coefficient could not be determined from the single well test

The results of the recovery test are considered to be representative because of the minimal well bore influence and because the one pumping rate measurement is probably representative because of the slight drawdown in the pumped well Also the recovery response would be less sensitive to possible fluctuations in pumping rate

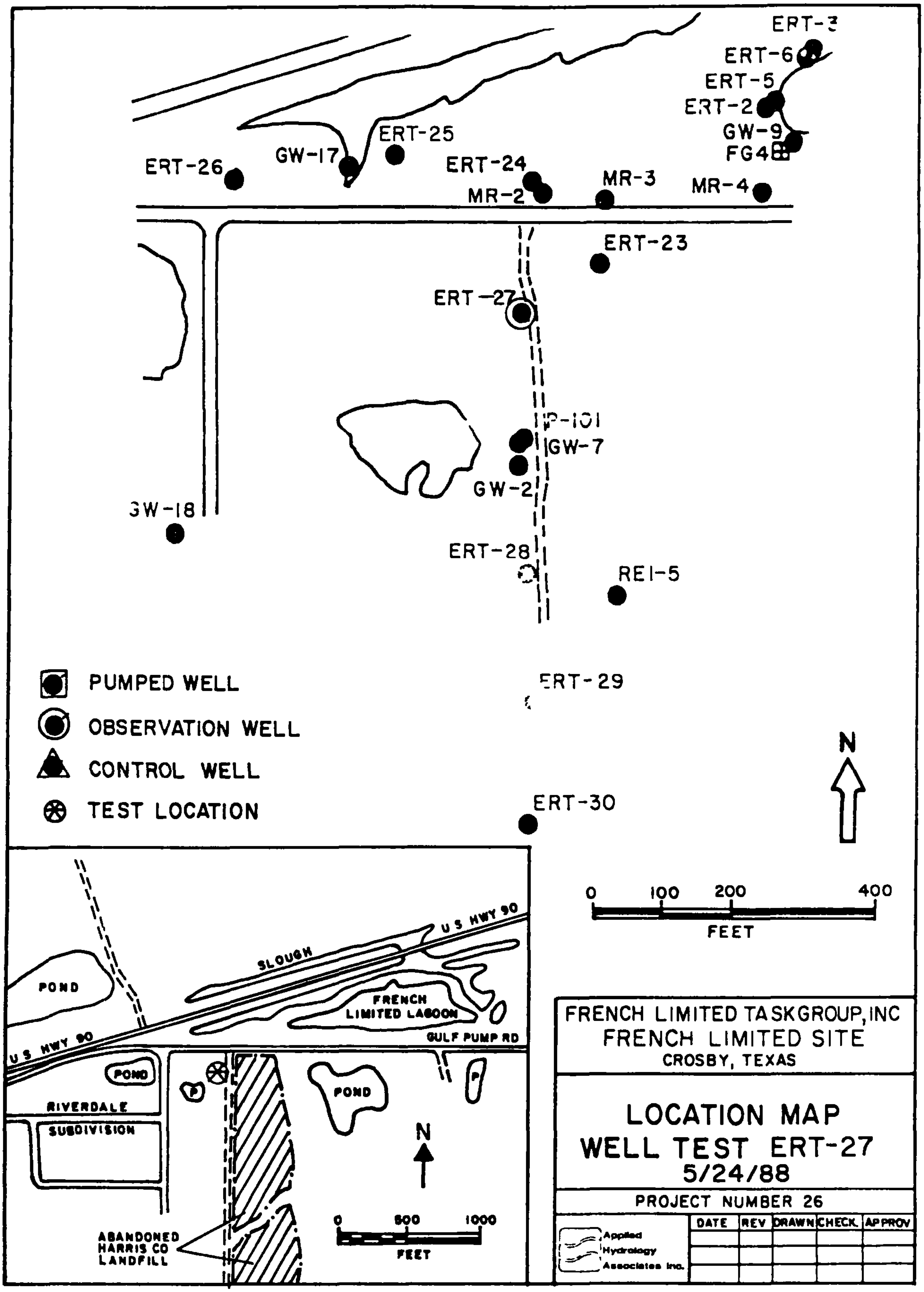
Well bore storage effects were significant for only about the first 2 5 minutes of the pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2.1 and shown below

$t_c < 0\ 6(16-1)/(13\ 04/3.52^{*}) - 2\ 43$ minutes

* used first drawdown measurement at 4 4 minutes into the test rather than at time $t_c$ which is less than 2 43 minutes into the pumping period

Consequently, the drawdown data for the first 2 5 minutes of both the drawdown and recovery periods should not be used for interpretation

023757


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-2
MR-3
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
POND
RIVERDALE
SUBDIVISION
POND
P
P
N
ABANDONED HARRIS CO LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-27
5/24/88
PROJECT NUMBER 26
DATE REV DRAWN CHECK APPROV
Applied Hydrology Associates Inc.

ERT 023759

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

# BORING LOG AND CONSTRUCTION OF ERT-27

Client: [illegible]
Project Name: [illegible]
Project Location: [illegible]
Job No.: [illegible]  Boring No.: [illegible]
Logged By: [illegible]
Approved By:
Drilled By: Southwestern Labs  Driller's Name: [illegible] Sandoval

**DRILLING AND SAMPLING INFORMATION**

Date Started: 3-29-85  Date Completed: [illegible]
Method: Mud [illegible]  Total Depth: 53 ft

**WELL COMPLETION INFORMATION**

Screen Dia.: 4 in.  Length: 40 ft
Slot Size: 0.010 in  Type: PVC
Casing Dia.: 4 in  Length: ~~[illegible]~~ 5 ft.

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Very dense brown and tan fill; rock and shell fragments. | J-1 | SS | 1.5 | | 21-33-24 | | 0 | | |
| 5 | Medium dense tan to gray fine sand, little shell fragments (SW-SP) | J-2 | SS | 5.0 | | 4-7-12 | | 0 | | |
| 10 | -10' fine to medium | J-3 | SS | 10.0 | | 4-10-10 | | 0 | | |
| 15 | | | | | | | | | | |
| 20 | -20' fine to coarse (20.0') | J-4 | SS | 20.0 | | 12-5-2 | | 0 | | |
| | Soft gray and brown silty clay (CL) (23.5') | | | | | | | | | |
| | Loose tan coarse sand well sorted (SW) (24.5') | | | | | | | | | |
| 25 | Stiff gray and red clay (CH-CL) | J-5 | SS | 25.0 | | 2-4-5 | | 0 | | |
| 30 | -30' gray, tan, and red, silty, trace dark brown patches (33.5') | J-6 | SS | 30.0 | 2.0 | 2-5-10 | | 0 | | |
| 35 | Dense tan fine sandy silt, trace rust-colored patches (ML) | J-7 | SS | 35.0 | | 15-45 [illegible] | | [illegible] | | |
| 40 | -40' some black mottling (43.5') | J-8 | SS | 40.0 | | 6-15-10 | | [illegible] | | |
| 45 | Soft to stiff, tan to gray fine sandy clay. Consistency varies throughout sample. (CL) (48.0') | J-9 | SS | 45.0 | | 5-15-15 | | 0 | | |
| 50 | Stiff brownish-red, gray, and yellow streaked clay, some silt partings, slickensided. (CH) (53.0') | J-10 | ST | 50.5 | 4.25 | | | 0 | | |
| | Boring terminated at 53 ft | | | | | | | | | 53' |
| 55 | | | | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

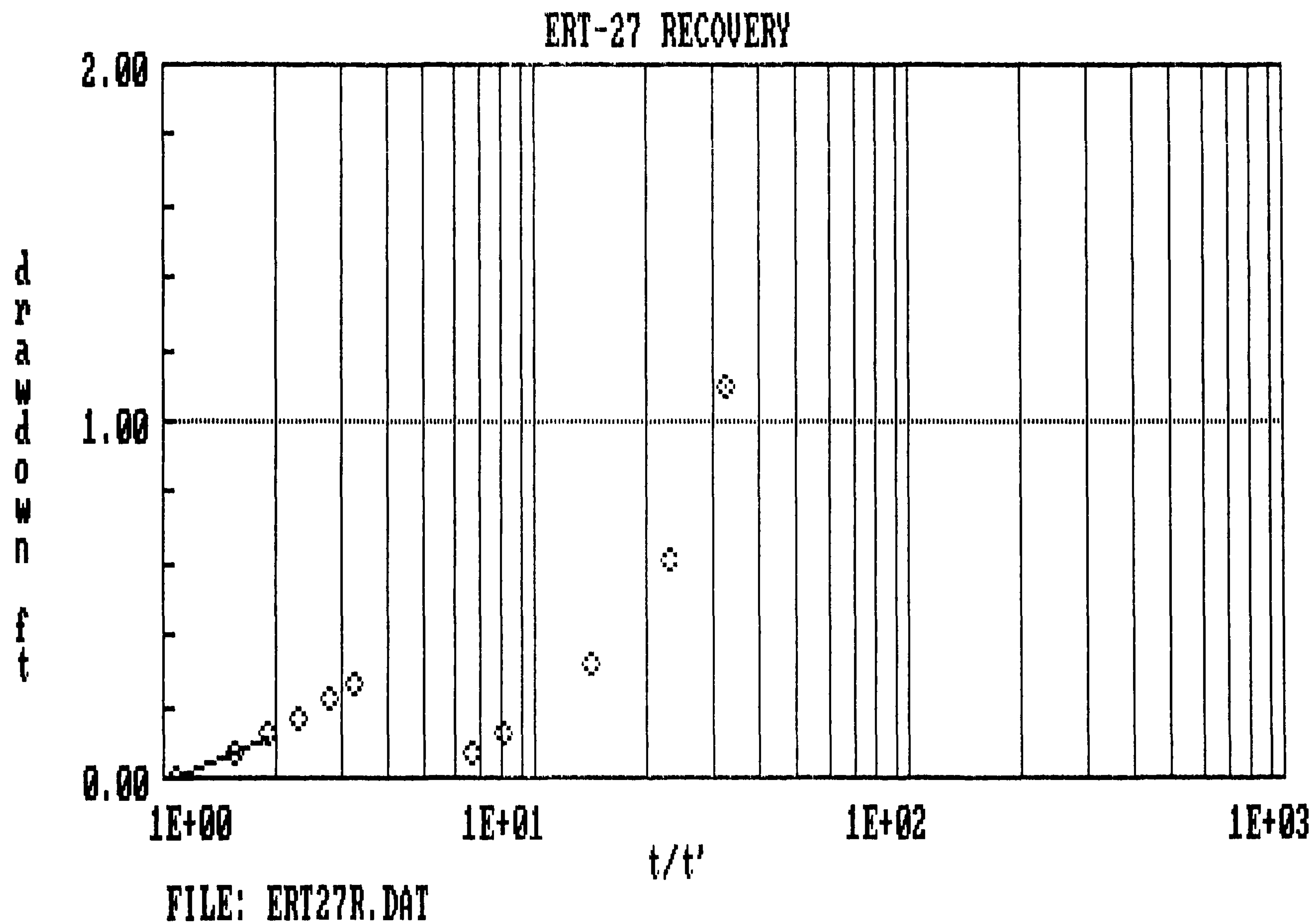
**BORING METHOD**
HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

023759

FRENCH LIMITED
CROSBY, TX
WELL ERT-27

DATE: 5/24/88
STATIC WATER LEVEL: 5.88 FEET
PUMPING RATE: 13.04 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 38.63 FEET (SOUNDED)
AQUIFER THICKNESS: 38.63 - 5.88 = 32.75 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 4.40 | | 9.40 | 3.52 | 3.33 | 5 gal/23.0 sec |
| 5.48 | | 9.45 | 3.57 | 3.38 | |
| 6.82 | | 9.40 | 3.52 | 3.33 | |
| 7.23 | | | | | Pump Off |
| 7.47 | 0.23 | 7.00 | 1.12 | 1.10 | |
| 7.57 | 0.33 | 6.50 | 0.62 | 0.61 | |
| 7.78 | 0.55 | 6.20 | 0.32 | 0.32 | |
| 8.23 | 1.00 | 6.00 | 0.12 | 0.12 | |
| 8.48 | 1.25 | 5.95 | 0.07 | 0.07 | |
| 10.48 | 3.25 | 6.15 | 0.27 | 0.27 | |
| 11.32 | 4.08 | 6.10 | 0.22 | 0.22 | |
| 12.85 | 5.62 | 6.05 | 0.17 | 0.17 | |
| 15.38 | 8.15 | 6.00 | 0.12 | 0.12 | |
| 20.65 | 13.42 | 5.95 | 0.07 | 0.07 | |
| 96.65 | 89.42 | 5.88 | 0.00 | 0.00 | |


ERT-27 RECOVERY
2.00
1.00
0.00
drawdown ft
1E+00
1E+01
1E+02
1E+03
t/t'
FILE: ERT27R.DAT

023760

023761

```
*******************************************************
*                                                     *
*              program:   Recovery                    *
*              version:   IBM PC 1.0                  *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-27
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  5.88 [ft]
DISCHARGE RATE............... =  13.04 [gpm]
DURATION OF PUMPING PERIOD... =  7.23 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 0.23 | 7.46 | 32.43 | 1.100 | +.000E+00 |
| 2 | 0.33 | 7.56 | 22.91 | 0.610 | +.000E+00 |
| 3 | 0.55 | 7.78 | 14.15 | 0.320 | +.000E+00 |
| 4 | 1.00 | 8.23 | 8.23 | 0.120 | +.000E+00 |
| 5 | 1.25 | 8.48 | 6.78 | 0.070 | +.000E+00 |
| 6 | 3.25 | 10.48 | 3.22 | 0.270 | +.108E-01 |
| 7 | 4.08 | 11.31 | 2.77 | 0.220 | +.509E-02 |
| 8 | 5.62 | 12.85 | 2.29 | 0.170 | +.279E-03 |
| 9 | 8.15 | 15.38 | 1.89 | 0.120 | +.250E-02 |
| 10 | 13.42 | 20.65 | 1.54 | 0.070 | -.394E-03 |
| 11 | 89.42 | 96.65 | 1.08 | 0.000 | +.144E-02 |

TRANSMISSIVITY T = .108E-01 [ft2/s]
T = 7001 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair 9
- ending with data pair 11

DETERMINATION COEFFICENT = .9967135

*****************************************************

# FRENCH LIMITED SITE
# PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 24, 1988

PUMPED WELL. ERT-28

OBSERVATION WELLS ERT-28

CONTROL WELLS· none

## BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-28 precede the aquifer test data which follow Prior to purging the well the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump Only one water level measurement was taken with the electric sounder before the well bore was pumped dry and the pump stopped at 4 25 minutes into the test Recovery measurements were taken for aver six hours following the test Because of the short duration of the test, only one flow measurements was taken at the start of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

## INTERPRETATION

Water level measurements were performed on the pumped well, ERT-28 Because of the short pumping time, only the recovery data were analyzed This was done via use of the RECOVERY program in the nonproprietary PUMPTEST package (Beljin, 1986) which is based on the Theis (1935) recovery method and available from the International Ground Water Modeling Center The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line. Because of the short duration of the pumping period, it was thought appropriate to also analyze the data via a slug test methodology This was done by use of the nonproprietary TIMELAG program (Thompson, 1987) available from the IGWMC. The TIMELAG program is based upon the technique of Hvorslev (1951) for the interpretation of slug tests in confined and unconfined aquifers

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the transmissivity estimate resulting from the RECOVERY analysis of the recovery data is 167 gpd/ft The average hydraulic conductivity was determined to be 1 $5 \times 10^{-4}$ cm/sec The storage coefficient could not be determined from the single well test

The analysis using TIMELAG assumes that the well bore is evacuated instantaneously and thus does not require a pumping rate measurement The method is not sensitive to the finite time needed to evacuate the well bore provided it is several orders of magnitude shorter than the recovery response period This method uses uncorrected water level data The water level was not measured until almost two minutes after purging stopped because of the pump removal activity The water level at the end of purging was estimated by extrapolating the early recovery data back to time zero on a semilog recovery plot The transmissivity calculated using TIMELAG is 52 gpd/ft and the average hydraulic conductivity is determined to be 4 $8 \times 10^{-5}$ cm/sec The storage coefficient could not be determined from the single well test

The results of these analyses are attached The results of the slug test analysis are considered fair given that slug tests generally provide only order-of-magnitude estimates of transmissivity The results of the recovery test are considered poor given that only four of the recovery data points were outside the significant influence of well bore storage Even though the recovery response us less sensitive to possible fluctuations in pumping rate, it is suspected that much of the discrepancy between the results of the slug test and recovery analyses is due to the accuracy of the pumping rate measurement Given the relatively large drawdown in the pumped well, it is possible that the actual rate may have declined near the end of pumping Consequently, the pumping rate measurement which was taken during the middle of the test may be somewhat higher than the average for the entire pumping period resulting in a slight overestimation of transmissivity using the recovery analysis technique

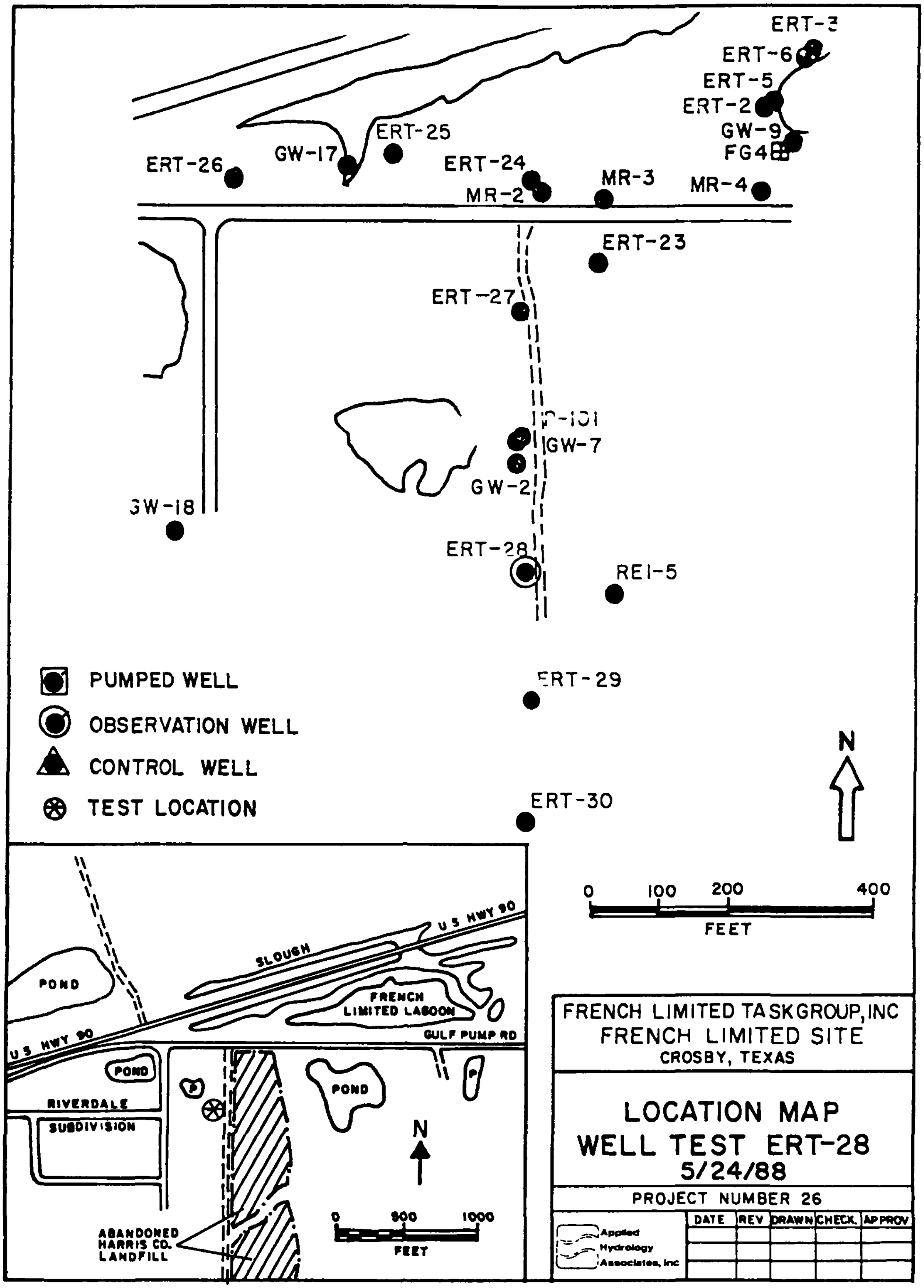
Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in section B-2 1 and shown below

$$t_c > 0\ 6(16-1)/(10\ 95/36^{*}) = 29.6 \text{ minutes}$$

* drawdown estimated at end of pumping rather than at time $t_c$ which is beyond the end of pumping

Consequently, the drawdown data for the entire pumping interval should not be used for interpretation Likewise, since $t_c$ is greater than 29 6 minutes, only the last four recovery data points are in the range where well bore influences were minimal.

023791


ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-2
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
ERT-29
ERT-30
N
0
100
200
400
FEET
US HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE SUBDIVISION
ABANDONED HARRIS CO. LANDFILL
P
0
500
1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-28
5/24/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc
DATE
REV
DRAWN
CHECK.
APPROV

**ERI** 0..3705

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 2

# BORING LOG AND CONSTRUCTION OF ERT-28

Client: ARCO CHEMICAL
Project Name: [illegible] SITE
Project Location: [illegible], TX
Job No.: 9500-079-001
Boring No.: ERT-28
Logged By: J. [illegible]
Approved By:
Drilled By: SOUTHWESTERN LABS
Driller's Name: TONY SANDOVAL

**DRILLING AND SAMPLING INFORMATION**

Date Started: 3-27-88
Date Completed: 3-27-88
Method: Mud Rotary
Total Depth: 68 ft

**WELL COMPLETION INFORMATION**

Screen Dia.: 4 in
Length: 55 ft
Slot Size: 0.010 in
Type: PVC
Casing Dia.: 4 in
Length: ~~[illegible]~~ 8 ft

SURFACE ELEVATION

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.²) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Medium dense dark brown clay with shell and rock fill. | J-1 | SS | 1.0 | | 3-1-17 | | 0 | | |
| 5 | (4.5') Medium dense light gray fine sand (SW) | J-2 | SS | 5.0 | | 4-6-5 | | 0 | | |
| 10 | | J-3 | SS | 10.0 | | 5-17-10 | | 0 | | |
| 15 | -13.5' dark brown clay seam 2" thick | J-4 | SS | 15.0 | | 10-11-14 | | 0 | | |
| 20 | -19.0' light gray stiff clay seam 1" thick | J-5 | SS | 20.0 | | 3-4-5 | | 0 | | |
| 25 | (24.0') Medium dense dark gray clayey sand (SC) | J-6 | SS | 25.0 | | 2-4-12 | | 0 | | |
| 30 | (29.0') Stiff light tan and red clay (CH) | J-7 | SS | 30.0 | | 4-7-9 | | 0 | | |
| 35 | | J-8 | SS | 35.0 | | 5-10-17 | | 0 | | |
| 40 | (39.5') Very dense light brown and light gray clayey sand, some silt (SC). | J-9 | SS | 40.0 | | 6-10-25 | | 0 | | |
| 45 | | J-10 | SS | 45.0 | | 15-30-47 | | 0 | | |
| 50 | | J-11 | SS | 50.0 | | 8-14-17 | | 0 | | |
| 55 | | J-12 | SS | 55.0 | | 14-23-32 | | 0 | | |
| 60 | | | | | | | | | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON    CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE    RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS    DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS    MD - MUD DRILLING

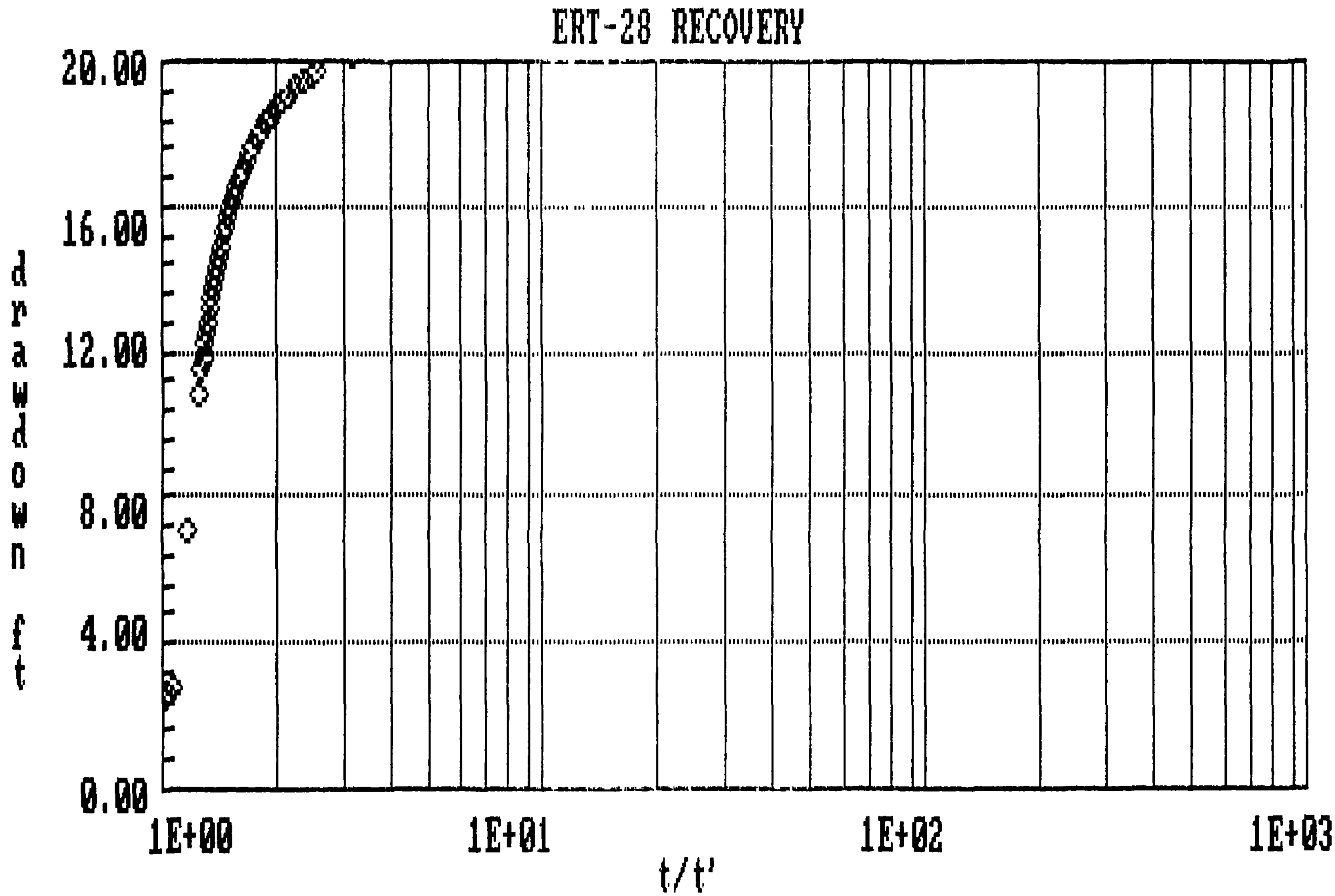
023760

FRENCH LIMITED
CROSBY, TX
WELL ERT-28

DATE: 5/24/88
STATIC WATER LEVEL: 11.89 FEET
PUMPING RATE: 10.95 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 55.55 FEET (SOUNDED)
AQUIFER THICKNESS: 55.55 - 11.89 = 43.66 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 0.97 | | 16.75 | 4.86 | 4.59 | |
| 4.23 | | | | | 5 gal/27.4 sec |
| 4.25 | | | | | Pump Off, Well Dry |
| 6.20 | 1.95 | 43.50 | 31.61 | 20.17 | |
| 7.03 | 2.78 | 42.00 | 30.11 | 19.73 | |
| 7.13 | 2.88 | 41.50 | 29.61 | 19.57 | |
| 7.37 | 3.12 | 41.00 | 29.11 | 19.41 | |
| 7.67 | 3.42 | 40.50 | 28.61 | 19.24 | |
| 7.92 | 3.67 | 40.00 | 28.11 | 19.06 | |
| 8.20 | 3.95 | 39.50 | 27.61 | 18.88 | |
| 8.48 | 4.23 | 39.00 | 27.11 | 18.69 | |
| 8.78 | 4.53 | 38.50 | 26.61 | 18.50 | |
| 9.08 | 4.83 | 38.00 | 26.11 | 18.30 | |
| 9.42 | 5.17 | 37.50 | 25.61 | 18.10 | |
| 9.70 | 5.45 | 37.00 | 25.11 | 17.89 | |
| 10.00 | 5.75 | 36.50 | 24.61 | 17.67 | |
| 10.33 | 6.08 | 36.00 | 24.11 | 17.45 | |
| 10.67 | 6.42 | 35.50 | 23.61 | 17.23 | |
| 11.00 | 6.75 | 35.00 | 23.11 | 16.99 | |
| 11.38 | 7.13 | 34.50 | 22.61 | 16.76 | |
| 11.75 | 7.50 | 34.00 | 22.11 | 16.51 | |
| 12.12 | 7.87 | 33.50 | 21.61 | 16.26 | |
| 12.52 | 8.27 | 33.00 | 21.11 | 16.01 | |
| 12.93 | 8.68 | 32.50 | 20.61 | 15.75 | |
| 13.30 | 9.05 | 32.00 | 20.11 | 15.48 | |
| 13.72 | 9.47 | 31.50 | 19.61 | 15.21 | |
| 14.20 | 9.95 | 31.00 | 19.11 | 14.93 | |
| 14.67 | 10.42 | 30.50 | 18.61 | 14.64 | |
| 15.03 | 10.78 | 30.00 | 18.11 | 14.35 | |
| 15.50 | 11.25 | 29.50 | 17.61 | 14.06 | |
| 15.95 | 11.70 | 29.00 | 17.11 | 13.76 | |
| 16.45 | 12.20 | 28.50 | 16.61 | 13.45 | |
| 16.97 | 12.72 | 28.00 | 16.11 | 13.14 | |
| 17.47 | 13.22 | 27.50 | 15.61 | 12.82 | |
| 18.03 | 13.78 | 27.00 | 15.11 | 12.50 | |
| 18.63 | 14.38 | 26.50 | 14.61 | 12.17 | |
| 19.25 | 15.00 | 26.00 | 14.11 | 11.83 | |

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 21.00 | 16.75 | 25.50 | 13.61 | 11.49 | |
| 21.33 | 17.08 | 24.50 | 12.61 | 10.79 | |
| 30.47 | 26.22 | 19.70 | 7.81 | 7.11 | |
| 63.92 | 59.67 | 14.77 | 2.88 | 2.79 | |
| 139.50 | 135.25 | 14.64 | 2.75 | 2.66 | |
| 323.30 | 319.10 | 14.50 | 2.61 | 2.53 | |
| 377.20 | 372.90 | 14.48 | 2.59 | 2.51 | |




FILE: ERT28R.DAT



023780

023769

```
*********************************************************
*                                                       *
*              program:  Recovery                       *
*              version:  IBM PC 1.0                     *
*                                                       *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S       *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.    *
*                                                       *
*********************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-28
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.    =  11.89 [ft]
DISCHARGE RATE.............. =  10.95 [gpm]
DURATION OF PUMPING PERIOD... =  4.25 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 1.95 | 6.20 | 3.18 | 20.170 | +.000E+00 |
| 2 | 2.78 | 7.03 | 2.53 | 19.730 | +.000E+00 |
| 3 | 2.88 | 7.13 | 2.48 | 19.570 | +.000E+00 |
| 4 | 3.12 | 7.37 | 2.36 | 19.410 | +.000E+00 |
| 5 | 3.42 | 7.67 | 2.24 | 19.240 | +.000E+00 |
| 6 | 3.67 | 7.92 | 2.16 | 19.060 | +.000E+00 |
| 7 | 3.95 | 8.20 | 2.08 | 18.880 | +.000E+00 |
| 8 | 4.23 | 8.48 | 2.00 | 18.690 | +.000E+00 |
| 9 | 4.53 | 8.78 | 1.94 | 18.500 | +.000E+00 |
| 10 | 4.83 | 9.08 | 1.88 | 18.300 | +.000E+00 |
| 11 | 5.17 | 9.42 | 1.82 | 18.100 | +.000E+00 |
| 12 | 5.45 | 9.70 | 1.78 | 17.890 | +.000E+00 |
| 13 | 5.75 | 10.00 | 1.74 | 17.670 | +.000E+00 |
| 14 | 6.08 | 10.33 | 1.70 | 17.450 | +.000E+00 |
| 15 | 6.42 | 10.67 | 1.66 | 17.230 | +.000E+00 |
| 16 | 6.75 | 11.00 | 1.63 | 16.990 | +.000E+00 |
| 17 | 7.13 | 11.38 | 1.60 | 16.760 | +.000E+00 |
| 18 | 7.50 | 11.75 | 1.57 | 16.510 | +.000E+00 |
| 19 | 7.87 | 12.12 | 1.54 | 16.260 | +.000E+00 |
| 20 | 8.27 | 12.52 | 1.51 | 16.010 | +.000E+00 |
| 21 | 8.68 | 12.93 | 1.49 | 15.750 | +.000E+00 |
| 22 | 9.05 | 13.30 | 1.47 | 15.480 | +.000E+00 |
| 23 | 9.47 | 13.72 | 1.45 | 15.210 | +.000E+00 |
| 24 | 9.95 | 14.20 | 1.43 | 14.930 | +.000E+00 |
| 25 | 10.42 | 14.67 | 1.41 | 14.640 | +.000E+00 |
| 26 | 10.78 | 15.03 | 1.39 | 14.350 | +.000E+00 |
| 27 | 11.25 | 15.50 | 1.38 | 14.060 | +.000E+00 |
| 28 | 11.70 | 15.95 | 1.36 | 13.760 | +.000E+00 |
| 29 | 12.20 | 16.45 | 1.35 | 13.450 | +.000E+00 |
| 30 | 12.72 | 16.97 | 1.33 | 13.140 | +.000E+00 |
| 31 | 13.22 | 17.47 | 1.32 | 12.820 | +.000E+00 |
| 32 | 13.78 | 18.03 | 1.31 | 12.500 | +.000E+00 |
| 33 | 14.38 | 18.63 | 1.30 | 12.170 | +.000E+00 |
| 34 | 15.00 | 19.25 | 1.28 | 11.830 | +.000E+00 |
| 35 | 16.75 | 21.00 | 1.25 | 11.490 | +.000E+00 |
| 36 | 17.08 | 21.33 | 1.25 | 10.790 | +.000E+00 |
| 37 | 26.22 | 30.47 | 1.16 | 7.110 | +.495E+00 |
| 38 | 59.67 | 63.92 | 1.07 | 2.790 | -.118E+01 |
| 39 | 135.25 | 139.50 | 1.03 | 2.660 | -.291E-03 |
| 40 | 319.10 | 323.35 | 1.01 | 2.530 | +.300E-02 |
| 41 | 372.90 | 377.15 | 1.01 | 2.510 | -.271E-02 |

023770 TRANSMISSIVITY T = .258E-03 [ft2/s]
T = 167 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair 39
- ending with data pair 41

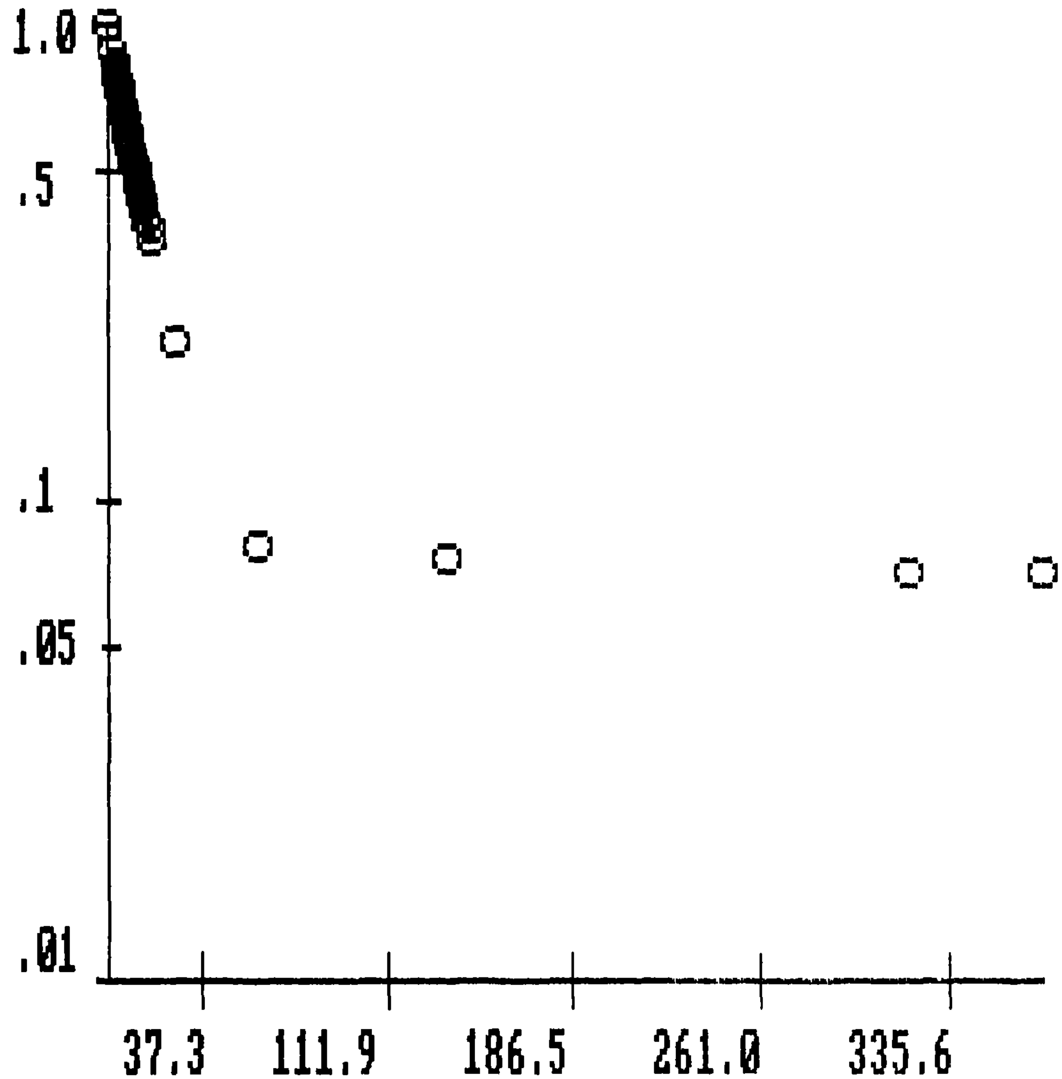
DETERMINATION COEFFICENT = .9987052

*****************************************************

023771

```
IMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
:                    PERMEABILITY FROM TIME-LAG TESTS
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

TITLE:  ? ERT-28 TIMELAG ANALYSIS
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? I
STANDPIPE RADIUS (inches) = ? 2
INTAKE RADIUS (inches) = ? 2
LENGTH OF INTAKE (feet or meters) = ? 44
DEPTH TO TOP OF INTAKE (feet or meters) = ? 5
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 11.9
PURGE WATER LEVEL (FEET OR METERS) = ? 47.9


ARE THESE DATA CORRECT? (Y/N)? Y
```

023772




X AXIS:
TIME, min

Y AXIS:
LOG (H/H0)

EXAMINE PLOT.
STRIKE ANY KEY WHEN READY.

ERT -28 TIMELAG ANALYSIS

ERT-28 TIMELAG ANALYSIS

| TIME (seconds) | WATER LEVEL (feets) | DRAWDOWN (feet) | H/HO |
|---|---|---|---|
| 0 | 47.9 | 36.00 | 1 |
| 117 | 43.5 | 31.60 | .8777778 |
| 166.8 | 42 | 30.10 | .8361111 |
| 172.8 | 41.5 | 29.60 | .8222222 |
| 187.2 | 41 | 29.10 | .8083333 |
| 205.2 | 40.5 | 28.60 | .7944444 |
| 220.2 | 40 | 28.10 | .7805556 |
| 237 | 39.5 | 27.60 | .7666667 |
| 253.8 | 39 | 27.10 | .7527778 |
| 271.8 | 38.5 | 26.60 | .7388889 |
| 289.8 | 38 | 26.10 | .725 |
| 310.2 | 37.5 | 25.60 | .7111111 |
| 327 | 37 | 25.10 | .6972222 |
| 345 | 36.5 | 24.60 | .6833333 |
| 364.8 | 36 | 24.10 | .6694444 |
| 385.2 | 35.5 | 23.60 | .6555556 |
| 405 | 35 | 23.10 | .6416667 |
| 427.8 | 34.5 | 22.60 | .6277778 |
| 450 | 34 | 22.10 | .6138889 |
| 472.2 | 33.5 | 21.60 | .6 |
| 496.2 | 33 | 21.10 | .5861111 |
| 520.8001 | 32.5 | 20.60 | .5722222 |
| 543 | 32 | 20.10 | .5583333 |
| 568.2 | 31.5 | 19.60 | .5444444 |
| 597 | 31 | 19.10 | .5305556 |
| 625.2 | 30.5 | 18.60 | .5166667 |
| 646.8 | 30 | 18.10 | .5027778 |
| 675 | 29.5 | 17.60 | .4888889 |
| 702 | 29 | 17.10 | .475 |
| 732 | 28.5 | 16.60 | .4611111 |
| 763.2 | 28 | 16.10 | .4472222 |
| 793.2 | 27.5 | 15.60 | .4333333 |
| 826.8 | 27 | 15.10 | .4194444 |
| 862.8 | 26.5 | 14.60 | .4055556 |
| 900 | 26 | 14.10 | .3916667 |
| 1005 | 25.5 | 13.60 | .3777778 |

UNCONFINED AQUIFER

K = 0.5E-04 cm/sec
  = 1.2 gpd/ft2
  = 0.2E-05 ft/sec
  = 0.2 ft/day

REGRESSION COEFFICIENT = -.998473

023774

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 24, 1988

PUMPED WELL. ERT-29

OBSERVATION WELLS. ERT-29

CONTROL WELLS· none

BACKGROUND AND DESCRIPTION OF TEST.

Lithologic and completion logs and an illustration of the location of well ERT-29 precede the aquifer test data which follow Prior to purging the well, the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump and water level measurements were taken with the electric sounder about eight times starting at 11 minutes into the test until the pump was shut off at 19 85 minutes after the start of pumping Recovery measurements were taken for over seven hours following the test Only one flow measurements was taken near the middle of the test using a five-gallon bucket and stop watch

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

INTERPRETATION

Water level measurements were performed on the pumped well, ERT-29 The adjusted drawdown data from the pumped well were analyzed using the nonproprietary program JACOBFIT in the PUMPTEST package (Beljin, 1986) available from the International Ground Water Modeling Center The program is based on the Cooper and Jacob (1946) approximation of the Theis equation The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where r is the radial distance between the pumped well and observation well (feet),
S is the storage coefficient (unitless)
T is the transmissivity ($ft^2$/day), and
t is the time since pumping started (days)

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The solution involves fitting a straight line to a plot of adjusted drawdown on an arithmetic scale against the time since pumping started on a log scale The change in drawdown over one log cycle of time is used to calculate transmissivity. The JACOBFIT program allows the user to interactively specify which data are to be used in fitting the straight line The recovery data were analyzed using the RECOVERY program (Beljin, 1986) based upon the Theis (1935) recovery method and available from the IGWMC The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line

Assuming that the one pumping rate measurement is representative of the average rate during well purging, the resulting transmissivity estimate is 330 gpd/ft using the drawdown data and 2158 gpd/ft using the recovery data The average hydraulic conductivity was determined to be $3\ 3x10^{-4}$ cm/sec and $2\ 1x10^{-3}$ cm/sec respectively for the drawdown and recovery results The storage coefficient could not be determined from the single well test The results of this analysis are attached

The results of the drawdown analysis should not be used since the test was under the influence of significant well bore storage effects throughout the entire pumping period The results of the recovery test are considered fair given that only four of the recovery data points were outside the significant influence of well bore storage The relatively poor comparisor between the drawdown and recovery results is due largely to the influence of well bore storage on the drawdown response Also the recovery response would be less sensitive to possible fluctuations in pumping rate Given the relatively large drawdown in the pumped well, it is possible that the actual flows may have declined near the end of pumping Consequently, the measurement which was taken during the middle of the test may be somewhat higher that the average for the entire pumping period which would result in a slight overestimation of transmissivity

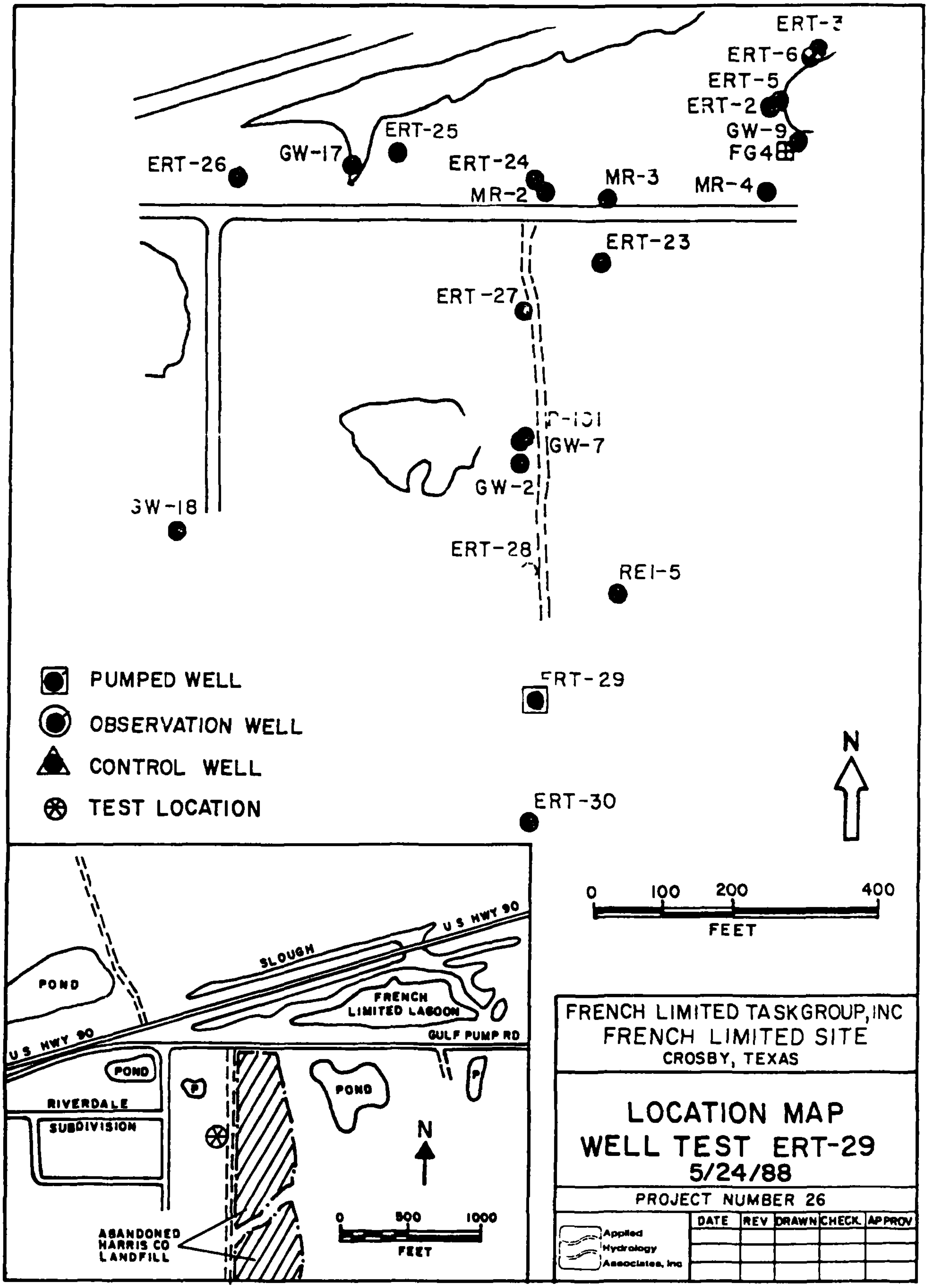
Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in the B-2 1 and shown below

$$t_c > 0\ 6(16-1)/(10.99/32\ 6^*) = 26.7 \text{ minutes}$$

* drawdown at the last measurement in the pumping period 16 55 minutes after the start of pumping

Consequently, the drawdown data for the entire pumping interval should not be used for interpretation. Likewise, since $t_c$ is greater than 26 7 minutes, only the last four recovery data points are in the range where well bore influences are minimal.

023776



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-2
MR-3
MR-4
ERT-23
ERT-27
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
US HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
POND
RIVERDALE
SUBDIVISION
POND
P
P
N
0 500 1000
FEET
ABANDONED HARRIS CO LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-29
5/24/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc
DATE
REV
DRAWN
CHECK.
APPROV

023 ERI

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-29

Client [illegible]
Project Name [illegible]
Project Location CROSBY, TX
Job No. [illegible]  Boring No. ERT-29
Logged By E. Patel
Approved By
Drilled By Southwestern Labs  Driller's Name Les Welch

**DRILLING AND SAMPLING INFORMATION**
Date Started 3-26-88  Date Completed 3-27-88
Method Mud Rotary  Total Depth 63 ft

**WELL COMPLETION INFORMATION**
Screen Dia. 4 in  Length 50 ft
Slot Size 0.010 in  Type PVC
Casing Dia. 4 in  Length ~~[illegible]~~ 6 ft.

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Light brown sand and gravel fill (1.0') | J-1 | SS | 1.0 | | 9-3-2 | | [illegible] | | |
| | Firm dark gray clay with sand partings (CH). (4.0') | | | | | | | | | |
| 5 | Dense dark gray silty fine sand (SM). | J-2 | SS | 5.0 | | 5-9-11 | | 0 | | |
| 10 | -8.5' light gray and brown, with occasional gravel and shell fragments | J-3 | SS | 10.0 | | 5-5-5 | | 0 | | |
| 15 | | J-4 | SS | 15.0 | | 5-14-19 | | 0 | | |
| | (18.0') | | | | | | | | | |
| 20 | Loose to medium dense light gray and brown sandy silt, with occasional medium to coarse sand. | J-5 | SS | 20.0 | | 9-11-10 | | 0 | | |
| | -23.0' clay pockets and partings, occasional rock fragments | | | | | | | | | |
| 25 | | J-6 | SS | 25.0 | | [illegible] | | 0 | | |
| | (28.0') Dense dark tan and light brown silty fine sand. | | | | | | | | | |
| 30 | (31.0') | J-7 | SS | 30.0 | | 3-21-31 | | 0 | | |
| | Very stiff dark brown and light gray clay, with silty sand pockets and slickensides (CH). | | | | | | | | | |
| 35 | | J-8 | ST | 35.0 | 4.0 | | | 0 | | |
| 40 | | J-9 | ST | 40.0 | 4.0 | | | 0 | | |
| | (43.0') | | | | | | | | | |
| 45 | Very dense light gray clayey silt, with sand pockets (ML). | J-10 | ST | 45.0 | 2.5 | | | 0 | | |
| 50 | | J-11 | SS | 50.0 | | 17-28-26 | | 0 | | |
| 55 | -54.0' light tan | J-12 | ST | 55.0 | 3.0 | | | 0 | | |
| | (59.0') Very stiff, reddish brown, dark tan and gray clay, some yellow and gray color bands and sandy silt partings (CH). | | | | | | | | | |
| 60 | | J-13 | ST | 60.0 | 4.0 | | | 0 | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

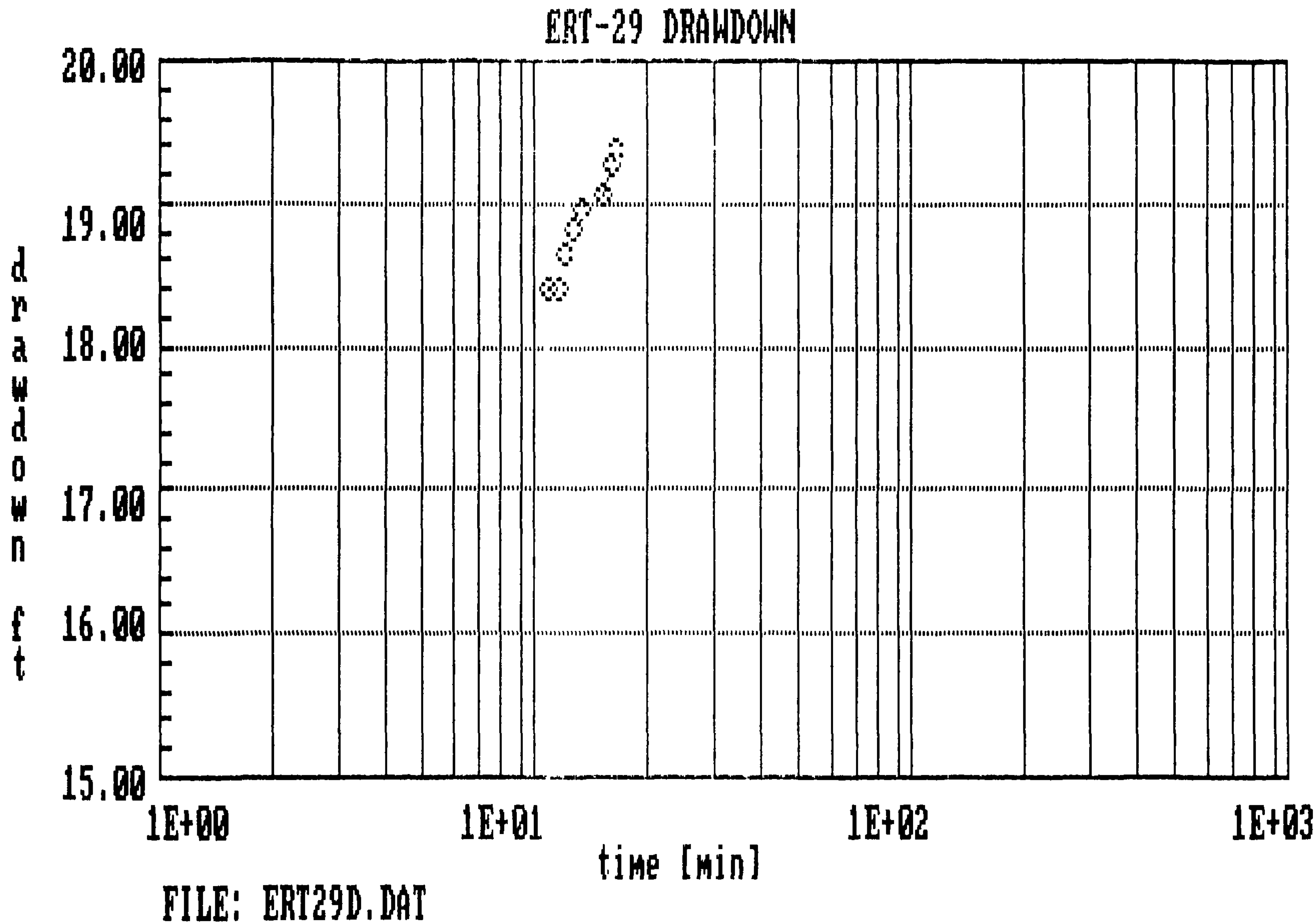
[redacted]

FRENCH LIMITED
CROSBY, TX
WELL ERT-29

DATE: 5/24/88
STATIC WATER LEVEL: 10.40 FEET
PUMPING RATE: 10.99 GPM
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 50.57 FEET (SOUNDED)
AQUIFER THICKNESS: 50.57 - 10.40 = 40.17 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 10.98 | | 38.92 | 28.52 | 18.40 | 5 gal/27.3 sec |
| 11.60 | | 39.02 | 28.62 | 18.42 | |
| 12.17 | | 39.80 | 29.40 | 18.64 | |
| 12.78 | | 40.50 | 30.10 | 18.82 | |
| 13.43 | | 41.00 | 30.60 | 18.95 | |
| 15.25 | | 41.50 | 31.10 | 19.06 | |
| 16.05 | | 42.50 | 32.10 | 19.27 | |
| 16.55 | | 43.00 | 32.60 | 19.37 | |
| 19.85 | | | | | Pump Off |
| 20.95 | 1.10 | 38.00 | 27.60 | 18.12 | |
| 21.18 | 1.33 | 37.50 | 27.10 | 17.96 | |
| 21.33 | 1.48 | 36.50 | 26.10 | 17.62 | |
| 21.65 | 1.80 | 35.00 | 24.60 | 17.07 | |
| 21.88 | 2.03 | 34.00 | 23.60 | 16.67 | |
| 22.17 | 2.32 | 33.00 | 22.60 | 16.24 | |
| 22.38 | 2.53 | 32.00 | 21.60 | 15.79 | |
| 22.62 | 2.77 | 30.00 | 19.60 | 14.82 | |
| 22.88 | 3.03 | 29.00 | 18.60 | 14.29 | |
| 23.42 | 3.57 | 28.00 | 17.60 | 13.74 | |
| 23.68 | 3.83 | 27.00 | 16.60 | 13.17 | |
| 23.97 | 4.12 | 26.00 | 15.60 | 12.57 | |
| 24.27 | 4.42 | 25.00 | 14.60 | 11.95 | |
| 24.60 | 4.75 | 24.00 | 13.60 | 11.30 | |
| 24.95 | 5.10 | 23.00 | 12.60 | 10.62 | |
| 25.32 | 5.47 | 22.00 | 11.60 | 9.93 | |
| 25.73 | 5.88 | 21.00 | 10.60 | 9.20 | |
| 26.20 | 6.35 | 20.00 | 9.60 | 8.45 | |
| 26.70 | 6.85 | 19.00 | 8.60 | 7.68 | |
| 27.33 | 7.48 | 18.00 | 7.60 | 6.88 | |
| 28.00 | 8.15 | 17.00 | 6.60 | 6.06 | |
| 28.87 | 9.02 | 16.00 | 5.60 | 5.21 | |
| 29.90 | 10.05 | 15.00 | 4.60 | 4.34 | |
| 31.02 | 11.17 | 14.00 | 3.60 | 3.44 | |
| 32.60 | 12.75 | 13.00 | 2.60 | 2.52 | |
| 34.72 | 14.87 | 12.50 | 2.10 | 2.05 | |
| 35.38 | 15.53 | 12.00 | 1.60 | 1.57 | |
| 38.17 | 18.32 | 11.50 | 1.10 | 1.08 | |
| 42.35 | 22.50 | 11.50 | 1.10 | 1.08 | |

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t′ (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s′ (feet) | Comments |
|---|---|---|---|---|---|
| 51.42 | 31.57 | 10.81 | 0.41 | 0.41 | |
| 147.00 | 127.15 | 10.58 | 0.18 | 0.18 | |
| 225.10 | 205.20 | 10.58 | 0.18 | 0.18 | |
| 460.25 | 440.40 | 10.56 | 0.16 | 0.16 | |


ERT-29 DRAWDOWN
20.00
19.00
18.00
17.00
16.00
15.00
drawdown ft
1E+00
1E+01
1E+02
1E+03
time [min]
FILE: ERT29D.DAT

```
*******************************************************
*                                                     *
*              program:  JacobFit                     *
*              version:  IBM PC 1.0                   *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-29
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  10.4 [ft]
DISCHARGE RATE.............. =  10.99 [gpm]
DISTANCE OF OBSERVATION POINT =  1 [ft]

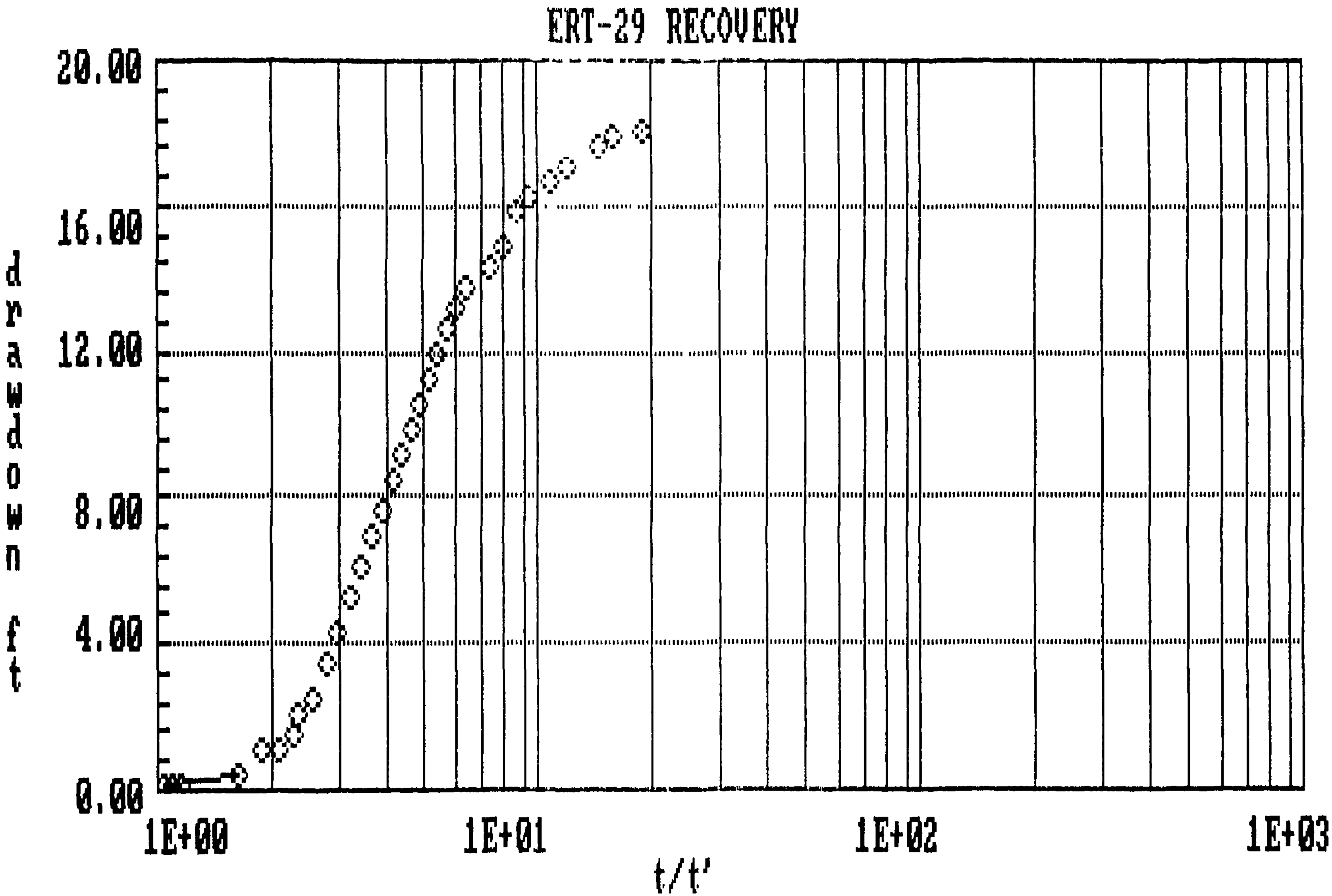
| NO | TIME [min] | DRAWDOWN [ft] | u | DEVIATION |
|---|---|---|---|---|
| 1 | 10.98 | 18.400 | .000E+00 | +.000E+00 |
| 2 | 11.60 | 18.420 | .000E+00 | +.000E+00 |
| 3 | 12.17 | 18.640 | .000E+00 | +.000E+00 |
| 4 | 12.78 | 18.820 | .000E+00 | +.000E+00 |
| 5 | 13.43 | 18.950 | .335E-04 | +.374E-01 |
| 6 | 15.25 | 19.060 | .360E-02 | -.427E-02 |
| 7 | 16.05 | 19.270 | .361E-02 | +.107E-01 |
| 8 | 16.55 | 19.370 | .350E-02 | -.639E-02 |

TRANSMISSIVITY  T = .511E-03 [ft2/s]
                T =    330 [gpd/ft]
STORATIVITY     S = .709E-02

DATA SEGMENT ANALYZED :
  - starting with data pair  6
  - ending   with data pair  8

DETERMINATION COEFFICENT = .9982535

*******************************************************




FILE: ERT29R.DAT

B-141

023782

023783

```
*********************************************************
*                                                       *
*              program:  Recovery                       *
*              version:  IBM PC 1.0                     *
*                                                       *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S       *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.    *
*                                                       *
*********************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-29
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.    =  10.4 [ft]
DISCHARGE RATE...............  =  10.99 [gpm]
DURATION OF PUMPING PERIOD...  =  19.85 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 1.10 | 20.95 | 19.05 | 18.120 | +.000E+00 |
| 2 | 1.33 | 21.18 | 15.92 | 17.960 | +.000E+00 |
| 3 | 1.48 | 21.33 | 14.41 | 17.620 | +.000E+00 |
| 4 | 1.80 | 21.65 | 12.03 | 17.070 | +.000E+00 |
| 5 | 2.03 | 21.88 | 10.78 | 16.670 | +.000E+00 |
| 6 | 2.32 | 22.17 | 9.56 | 16.240 | +.000E+00 |
| 7 | 2.53 | 22.38 | 8.85 | 15.790 | +.000E+00 |
| 8 | 2.77 | 22.62 | 8.17 | 14.820 | +.000E+00 |
| 9 | 3.03 | 22.88 | 7.55 | 14.290 | +.000E+00 |
| 10 | 3.57 | 23.42 | 6.56 | 13.740 | +.000E+00 |
| 11 | 3.83 | 23.68 | 6.18 | 13.170 | +.000E+00 |
| 12 | 4.12 | 23.97 | 5.82 | 12.570 | +.000E+00 |
| 13 | 4.42 | 24.27 | 5.49 | 11.950 | +.000E+00 |
| 14 | 4.75 | 24.60 | 5.18 | 11.300 | +.000E+00 |
| 15 | 5.10 | 24.95 | 4.89 | 10.620 | +.000E+00 |
| 16 | 5.47 | 25.32 | 4.63 | 9.930 | +.000E+00 |
| 17 | 5.88 | 25.73 | 4.38 | 9.200 | +.000E+00 |
| 18 | 6.35 | 26.20 | 4.13 | 8.450 | +.000E+00 |
| 19 | 6.85 | 26.70 | 3.90 | 7.680 | +.000E+00 |
| 20 | 7.48 | 27.33 | 3.65 | 6.880 | +.000E+00 |
| 21 | 8.15 | 28.00 | 3.44 | 6.060 | +.000E+00 |
| 22 | 9.02 | 28.87 | 3.20 | 5.210 | +.000E+00 |
| 23 | 10.05 | 29.90 | 2.98 | 4.340 | +.000E+00 |
| 24 | 11.17 | 31.02 | 2.78 | 3.440 | +.000E+00 |
| 25 | 12.75 | 32.60 | 2.56 | 2.520 | +.000E+00 |
| 26 | 14.87 | 34.72 | 2.33 | 2.050 | +.000E+00 |
| 27 | 15.53 | 35.38 | 2.28 | 1.570 | +.000E+00 |
| 28 | 18.32 | 38.17 | 2.08 | 1.080 | +.000E+00 |
| 29 | 22.50 | 42.35 | 1.88 | 1.080 | +.208E+00 |
| 30 | 31.57 | 51.42 | 1.63 | 0.410 | +.503E-02 |
| 31 | 127.15 | 147.00 | 1.16 | 0.180 | -.249E-01 |
| 32 | 205.20 | 225.05 | 1.10 | 0.180 | +.586E-02 |
| 33 | 440.40 | 460.25 | 1.05 | 0.160 | +.140E-01 |

TRANSMISSIVITY T = .334E-02 [ft2/s]
T =   2158 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair  30
- ending   with data pair  33

02?784

DETERMINATION COEFFICIENT = .9792542

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

023735

FRENCH LIMITED SITE
PRELIMINARY AQUIFER TESTING RESULTS

DATE OF TEST May 24, 1988

PUMPED WELL ERT-30

OBSERVATION WELLS ERT-30

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

Lithologic and completion logs and an illustration of the location of well ERT-30 precede the aquifer test data which follow. Prior to purging the well, the depth to static water level below the top of casing in the pumped well was measured using an electronic well sounder with accuracy to 01 feet The well was purged with a submersible pump No water level measurements were taken before the well bore was pumped dry and the pump stopped at 2 0 minutes into the test Recovery measurements were taken for over eight hours following the test Because of the short duration of the test, no flow measurements were taken during the short pumping interval

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = measured drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements from the aquifer test analysis including the observed drawdowns and the corrected drawdowns No observation wells were measured during the test The water level at the end of purging was estimated by extrapolating the early recovery data back to time zero on a semilog recovery plot

Water produced from the test was pumped into temporary storage containers and eventually was dumped into the French Limited Lagoon

INTERPRETATION.

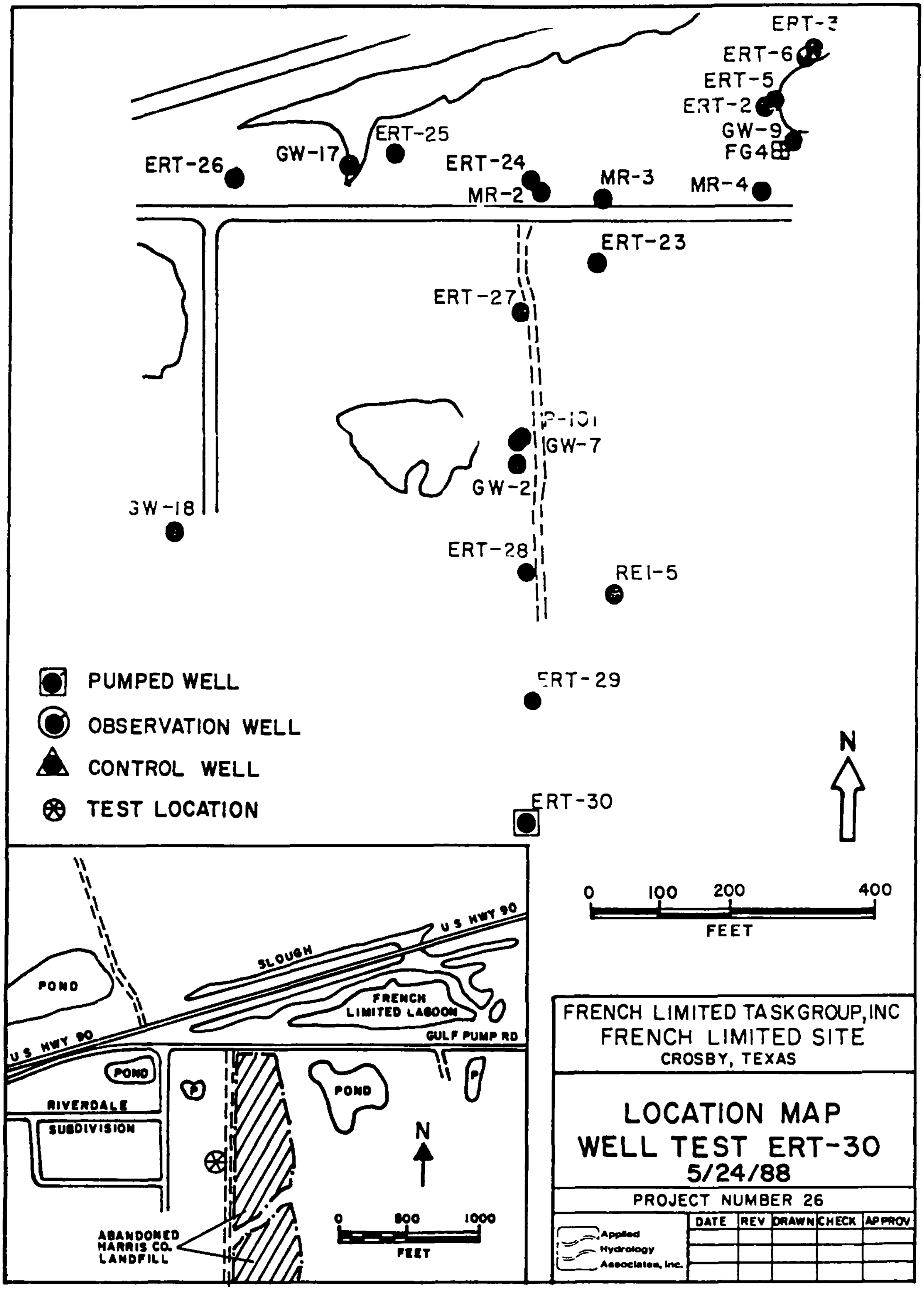
Water level measurements were performed on the pumped well, ERT-30 The adjusted drawdown data from the pumped well were analyzed using the nonproprietary pump test program RECOVERY (Beljin, 1986) available from the International Ground Water Modeling Center The results of that analysis, which follows, are considered to be poor because of the short pumping period. Uncorrected drawdown data were analyzed by use of the program TIMELAG (Thompson, 1987) also available from the International Ground Water

Modeling Center The TIMELAG program is based upon the technique of Hvorslev (1951) for the interpretation of slug tests. A slug test analysis was thought to be appropriate because of the short pumping period

The analysis using TIMELAG assumes that the well bore is evacuated instantaneously and thus does not require a pumping rate measurement The method is not sensitive to the finite time needed to evacuate the well bore provided it is several orders of magnitude shorter than the recovery response period. The water level was not measured until almost 2 5 minutes after purging stopped because of the pump removal activity The water level at the end of purging was estimated by extrapolating the recovery data back to time zero on a semilog plot The transmissivity calculated using TIMELAG is 63 gpd/ft and the average hydraulic conductivity is determined to be $7.43 \times 10^{-5}$ cm/sec The storage coefficient could not be determined from the single well test

The results of this analysis are attached The results of the slug test analysis are considered fair given that slug tests generally provide only order-of-magnitude estimates of transmissivity

023737



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG48
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-2
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE SUBDIVISION
P
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-30
5/24/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV
DRAWN
CHECK
APPROV

ERT 023788

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-30

Client [illegible]
Project Name [illegible]
Project Location CROSBY, TX.
Job No. [illegible] Boring No. ERT-30
Logged By C. Teller
Approved By
Drilled By Southwestern Labs Driller's Name L. Welch

DRILLING AND SAMPLING INFORMATION

Date Started 3-23-88 Date Completed 3-25-87
Method Mud Rotary Total Depth 58 ft

WELL COMPLETION INFORMATION

Screen Dia. 4 in Length 45 ft
Slot Size 0.010 in Type PVC
Casing Dia. 4 in Length 8 ft

| DEPTH IN FEET | DESCRIPTION<br>SURFACE ELEVATION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.²) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dense brown and black fill: shells, asphalt. (1.0') | | | | | | | (0.2) | | |
| | Loose tan fine sand, well sorted. (SW) | J-1 | SS | 2.0 | | | | 0.2 | | |
| 5 | | J-2 | SS | 5.0 | | 7-7-8 | | 0.2 | | |
| 10 | -10' fine to medium, some shell fragments | J-3 | SS | 10.0 | | 5-7-8 | | 0.2 | | |
| 15 | -16' no shell fragments, medium dense | J-4 | SS | 16.0 | | 7-12-19 | | 0.2 | | |
| 20 | -19' sandy clay layer (½ ft), fine sand below. | J-5 | SS | 20.0 | | 5-13-15 | | 0.2 | | |
| 25 | -25' fine to medium, one small (½ in) clay layer near bottom of sample, one rock fragment. (29.0') | J-6 | SS | 25.0 | | 18-27-23 | | 0.2 | | |
| 30 | Very stiff, brown with occasional gray patches, silty clay, little sand. One rock fragment at top of sample. (CL) | J-7 | SS | 30.0 | 3.25 | 5-5-10 | | 0.2 | | |
| 35 | -35' occasional black carbonaceous fragments and white to gray carbonate rock fragments. | J-8 | SS | 35.0 | 4.5 | 10-16-15 | | 0.2 | | |
| 40 | -40' gray, no carbonate fragments. | J-9 | SS | 40.0 | 3.25 | 7-8-14 | | 0.2 | | |
| 45 | (48.5') | J-10 | SS | 45.0 | 3.25 | 13-27-41 | | 0.2 | | |
| 50 | Dense light gray fine sandy silt (SM) (54.0') | J-11 | SS | 50.0 | | 24-34-41 | | 0.2 | | |
| 55 | Stiff reddish brown silty clay. Some yellow and gray patches and laminations. Fine sand and silt partings, occasional carbonate fragments (CL) | J-12 | SS | 55.0 | 3.75 | 18-18-15 | | 0.2 | | |
| | (58.0') | J-13 | ST | 57.0 | 4.25 | | | 0.2 | | |
| 60 | Boring terminated at 58 ft. | | | | | | | | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

**BORING METHOD**

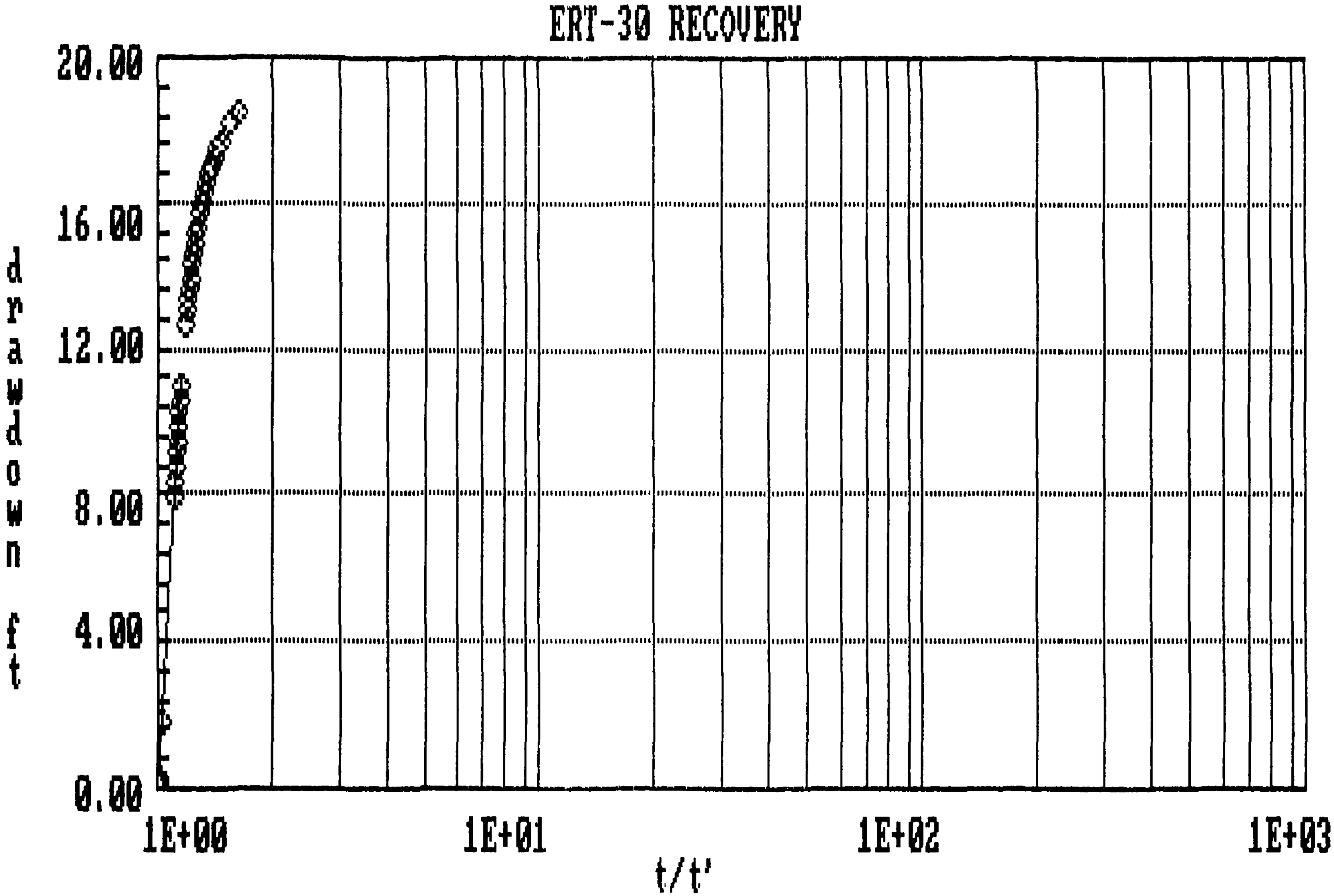
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

02^"37

FRENCH LIMITED
CROSBY, TX
WELL ERT-30

DATE: 5/24/88
STATIC WATER LEVEL: 13.70 FEET
PUMPING RATE: 11 GPM ASSUMED FROM OTHER TESTS. WELL WAS PUMPED DRY PRIOR TO MEASURING Q
DISTANCE TO OBSERVATION POINT: 1 FOOT
TOTAL DEPTH OF WELL: 58.40 FEET (SOUNDED)
AQUIFER THICKNESS: 58.40 - 13.70 = 44.70 FEET

| Time Since Pumping Started, t (minutes) | Time Since Pumping Stopped, t' (minutes) | Depth to Water (feet) | Drawdown (feet) | Corrected Drawdown, s' (feet) | Comments |
|---|---|---|---|---|---|
| 2.00 | | | | | Pump Off, Well Dry |
| 5.23 | 3.23 | 39.91 | 26.21 | 18.53 | |
| 5.70 | 3.70 | 39.00 | 25.30 | 18.14 | |
| 6.27 | 4.27 | 38.00 | 24.30 | 17.69 | |
| 6.57 | 4.57 | 37.50 | 23.80 | 17.46 | |
| 6.88 | 4.88 | 37.00 | 23.30 | 17.23 | |
| 7.22 | 5.22 | 36.50 | 22.80 | 16.99 | |
| 7.53 | 5.53 | 36.00 | 22.30 | 16.74 | |
| 7.87 | 5.87 | 35.50 | 21.80 | 16.48 | |
| 8.18 | 6.18 | 35.00 | 21.30 | 16.23 | |
| 8.52 | 6.52 | 34.50 | 20.80 | 15.96 | |
| 8.85 | 6.85 | 34.00 | 20.30 | 15.69 | |
| 9.23 | 7.23 | 33.30 | 19.60 | 15.30 | |
| 9.58 | 7.58 | 33.00 | 19.30 | 15.13 | |
| 9.92 | 7.92 | 32.50 | 18.80 | 14.85 | |
| 10.30 | 8.30 | 32.00 | 18.30 | 14.55 | |
| 10.68 | 8.68 | 31.50 | 17.80 | 14.26 | |
| 11.07 | 9.07 | 31.00 | 17.30 | 13.95 | |
| 11.45 | 9.45 | 30.50 | 16.80 | 13.64 | |
| 11.90 | 9.90 | 30.00 | 16.30 | 13.33 | |
| 12.28 | 10.28 | 29.50 | 15.80 | 13.01 | |
| 12.70 | 10.70 | 29.00 | 15.30 | 12.68 | |
| 15.05 | 13.05 | 26.50 | 12.80 | 10.97 | |
| 15.58 | 13.58 | 26.00 | 12.30 | 10.61 | |
| 16.12 | 14.12 | 25.50 | 11.80 | 10.24 | |
| 16.72 | 14.72 | 25.00 | 11.30 | 9.87 | |
| 17.33 | 15.33 | 24.50 | 10.80 | 9.50 | |
| 18.02 | 16.02 | 24.00 | 10.30 | 9.11 | |
| 18.73 | 16.73 | 23.50 | 9.80 | 8.73 | |
| 19.53 | 17.53 | 23.00 | 9.30 | 8.33 | |
| 20.33 | 18.33 | 22.50 | 8.80 | 7.93 | |
| 79.73 | 77.73 | 15.50 | 1.80 | 1.76 | |
| 173.70 | 171.70 | 14.02 | 0.32 | 0.32 | |
| 253.50 | 251.50 | 13.88 | 0.18 | 0.18 | |
| 489.90 | 487.90 | 13.78 | 0.08 | 0.08 | |




FILE: ERT30R.DAT

027731

```
*******************************************************
*                                                     *
*              program:  Recovery                     *
*              version:  IBM PC 1.0                   *
*                                                     *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S     *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.  *
*                                                     *
*******************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = ERT-30
DATE............ = 5/24/88

STATIC WATER LEVEL   S.W.L.   =  13.7 [ft]
DISCHARGE RATE............... =  11 [gpm]
DURATION OF PUMPING PERIOD... =  2 [min]

| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 3.23 | 5.23 | 1.62 | 18.530 | +.000E+00 |
| 2 | 3.70 | 5.70 | 1.54 | 18.140 | +.000E+00 |
| 3 | 4.27 | 6.27 | 1.47 | 17.690 | +.000E+00 |
| 4 | 4.57 | 6.57 | 1.44 | 17.460 | +.000E+00 |
| 5 | 4.88 | 6.88 | 1.41 | 17.230 | +.000E+00 |
| 6 | 5.22 | 7.22 | 1.38 | 16.990 | +.000E+00 |
| 7 | 5.53 | 7.53 | 1.36 | 16.740 | +.000E+00 |
| 8 | 5.87 | 7.87 | 1.34 | 16.480 | +.000E+00 |
| 9 | 6.18 | 8.18 | 1.32 | 16.230 | +.000E+00 |
| 10 | 6.52 | 8.52 | 1.31 | 15.960 | +.000E+00 |
| 11 | 6.85 | 8.85 | 1.29 | 15.690 | +.000E+00 |
| 12 | 7.23 | 9.23 | 1.28 | 15.300 | +.000E+00 |
| 13 | 7.58 | 9.58 | 1.26 | 15.130 | +.000E+00 |
| 14 | 7.92 | 9.92 | 1.25 | 14.850 | +.000E+00 |
| 15 | 8.30 | 10.30 | 1.24 | 14.550 | +.000E+00 |
| 16 | 8.68 | 10.68 | 1.23 | 14.260 | +.000E+00 |
| 17 | 9.07 | 11.07 | 1.22 | 13.950 | +.000E+00 |
| 18 | 9.45 | 11.45 | 1.21 | 13.640 | +.000E+00 |
| 19 | 9.90 | 11.90 | 1.20 | 13.330 | +.000E+00 |
| 20 | 10.28 | 12.28 | 1.19 | 13.010 | -.591E+00 |
| 21 | 10.70 | 12.70 | 1.19 | 12.680 | -.421E+00 |
| 22 | 13.05 | 15.05 | 1.15 | 10.970 | -.993E-01 |
| 23 | 13.58 | 15.58 | 1.15 | 10.610 | -.413E-01 |
| 24 | 14.12 | 16.12 | 1.14 | 10.240 | -.157E-01 |
| 25 | 14.72 | 16.72 | 1.14 | 9.870 | +.218E-01 |
| 26 | 15.33 | 17.33 | 1.13 | 9.500 | +.353E-01 |
| 27 | 16.02 | 18.02 | 1.12 | 9.110 | +.459E-01 |
| 28 | 16.73 | 18.73 | 1.12 | 8.730 | +.454E-01 |
| 29 | 17.53 | 19.53 | 1.11 | 8.330 | +.381E-01 |
| 30 | 18.33 | 20.33 | 1.11 | 7.930 | -.184E-02 |
| 31 | 77.73 | 79.73 | 1.03 | 1.760 | +.110E+00 |
| 32 | 171.70 | 173.70 | 1.01 | 0.320 | -.218E+00 |
| 33 | 251.50 | 253.50 | 1.01 | 0.180 | -.642E-01 |
| 34 | 487.90 | 489.90 | 1.00 | 0.080 | +.144E+00 |

TRANSMISSIVITY T = .243E-04 [ft2/s]
               T =      16 [gpd/ft]

DATA SEGMENT ANALYZED :

- ending with data pair 34

DETERMINATION COEFFICENT = .9995468

******************************************************

```
IMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
:                            PERMEABILITY FROM TIME-LAG TESTS
HMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

TITLE:  ? ERT-30 TIMELAG ANALYSIS
(E)nglish or (M)etric units? E
(C)onfined or (U)nconfined conditions? U
Do you prefer to enter well radii as (I)nches or (F)eet? I
STANDPIPE RADIUS (inches) = ? 2
INTAKE RADIUS (inches) = ? 2
LENGTH OF INTAKE (feet or meters) = ? 44
DEPTH TO TOP OF INTAKE (feet or meters) = ? 5
STATIC WATER LEVEL, DEPTH (feet or meters) = ? 13.7
PURGE WATER LEVEL (FEET OR METERS) = ? 47.1


ARE THESE DATA CORRECT? (Y/N)? Y
```

023734

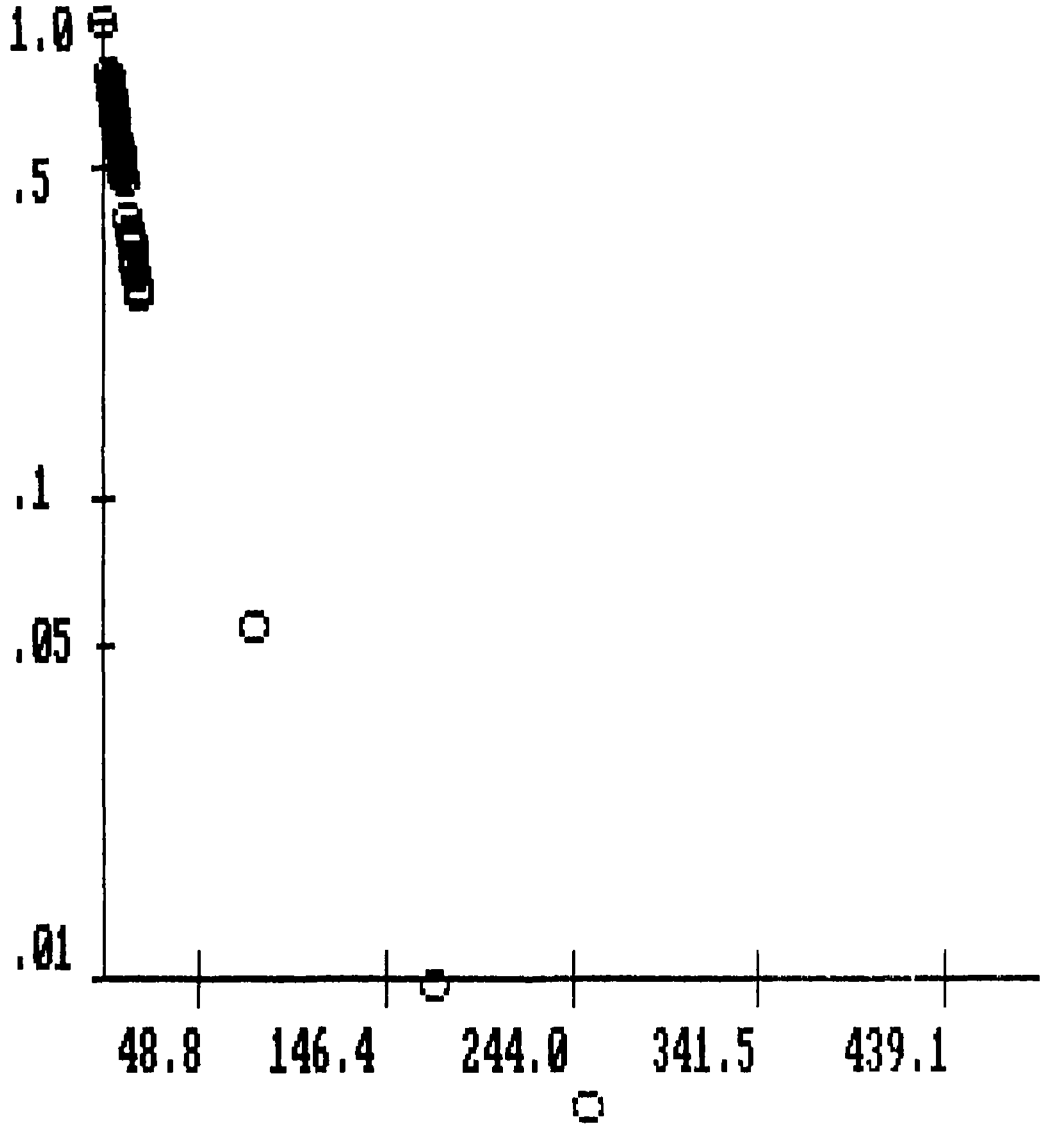
ERT-30 TIMELAG ANALYSIS

| TIME (seconds) | WATER LEVEL (feets) | DRAWDOWN (feet) | H/HO |
|---|---|---|---|
| 0 | 47.1 | 33.40 | 1 |
| 193.8 | 39.91 | 26.21 | .7847305 |
| 222 | 39 | 25.30 | .757485 |
| 256.2 | 38 | 24.30 | .7275449 |
| 274.2 | 37.5 | 23.80 | .7125748 |
| 292.8 | 37 | 23.30 | .6976048 |
| 313.2 | 36.5 | 22.80 | .6826347 |
| 331.8 | 36 | 22.30 | .6676647 |
| 352.2 | 35.5 | 21.80 | .6526946 |
| 370.8 | 35 | 21.30 | .6377245 |
| 391.2 | 34.5 | 20.80 | .6227545 |
| 411 | 34 | 20.30 | .6077845 |
| 433.8 | 33.3 | 19.60 | .5868264 |
| 454.8 | 33 | 19.30 | .5778443 |
| 475.2 | 32.5 | 18.80 | .5628743 |
| 498 | 32 | 18.30 | .5479042 |
| 520.8001 | 31.5 | 17.80 | .5329341 |
| 544.2 | 31 | 17.30 | .5179641 |
| 567 | 30.5 | 16.80 | .502994 |
| 594 | 30 | 16.30 | .4880239 |
| 616.8 | 29.5 | 15.80 | .4730539 |
| 642 | 29 | 15.30 | .4580838 |
| 783 | 26.5 | 12.80 | .3832335 |
| 814.8 | 26 | 12.30 | .3682635 |
| 847.2 | 25.5 | 11.80 | .3532934 |
| 883.2 | 25 | 11.30 | .3383233 |
| 919.8 | 24.5 | 10.80 | .3233533 |
| 961.2 | 24 | 10.30 | .3083832 |
| 1003.8 | 23.5 | 9.80 | .2934132 |
| 1051.8 | 23 | 9.30 | .2784432 |
| 1099.8 | 22.5 | 8.80 | .2634731 |

UNCONFINED AQUIFER

K = 0.7E-04 cm/sec
  = 1.4 gpd/ft2
  = 0.2E-05 ft/sec
  = 0.2 ft/day

REGRESSION COEFFICIENT = -.9998974




X AXIS:
TIME, min

Y AXIS:
LOG (H/H0)

EXAMINE PLOT.
STRIKE ANY KEY WHEN READY.

ERT-30 TIMELAG ANALYSIS



0237315

023736

# ATTACHMENT 2

UPPER ALLUVIAL ZONE PUMP TEST DATA AND INTERPRETATION

FRENCH LIMITED SITE,

Crosby, Texas

August 5 to August 15, 1988

023737

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST· August 8, 1988

PUMPED WELL: REI-10-2

OBSERVATION WELLS· REI-10-3, radial distance 80 88 feet and
REI-10-4, radial distance 53 77 feet

CONTROL WELLS none

BACKGROUND AND DESCRIPTION OF TEST

The original work plan included testing well REI-10-3 In the review of the work plan, Ms Kathleen O'Reiley of Region VI of the U S EPA expressed concern that the REI-10-3 well may not be representative because of the low transmissivity associated with the single well recovery analysis of the short term (15- minute) test performed on May 26, 1988 It appeared that the low transmissivity calculated from the short term single well test results could have been due to well inefficiency as suggested by the low pumping rate and large drawdown in this well Such well inefficiency would also cause well bore storage effects to be significant for unconfined conditions. Well bore effects could also contribute to the lower transmissivity estimate for this short term test

It was agreed by personnel from Region VI of the U S EPA that contractors to the French Limited Task Group, Inc would perform a step-drawdown or variable rate test on wells REI-10-2, REI-10-3 and REI-10-4 in order to select a well for a six- to eight-hour pumping test The contractors performing the pump test, Applied Hydrology Associates, Inc (AHA) and ERT, proposed to pump each well for 30 minutes at 1 5 gpm, then raise the pumping rate to 2 5 gpm for 30 minutes and then pump for an additional 30 minutes at a higher rate if drawdown had not approached the pumping level It was agreed that the test would be terminated if drawdown to the pump caused the pumping rate to drop significantly. Recovery measurements would be taken following termination of pumping

A variable rate test was performed on well REI-10-2 by AHA and ERT personnel Lithologic and well completion logs and an illustration of the location of the pumped well, REI-10-2, and the observation wells, REI-10-3 and REI-10-4, precede the aquifer test data which follow.

Prior to pumping the well, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to 01 feet The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder on the pumped well and on wells REI-10-3 and REI-10-4

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

The attached data sheets present the measurements for the pumped well and the observation wells during the drawdown and recovery periods The data sheets include the observed drawdowns and the corrected drawdowns

Because of the low yield obtained from well REI-10-2, the flow as measured by an in-line Rotometer was set at a rate of 1.0 gpm Several measurements with a five-gallon bucket and stop watch showed the actual rate to be 0 83 gpm It was decided to pump at this rate for at least one hour in order to overcome well bore effects. However, the drawdown reached the pump level after 34 minutes of pumping, so it was necessary to reduce the pumping rate to about 0 4 gpm as shown by the Rotometer Subsequent measurements with a five-gallon bucket and stop watch showed this pumping rate to be about 0 59 gpm

The well was pumped at about 0 59 gpm until drawdown approached the pump level Pumping was terminated after pumping at this rate for about 66 minutes The total pumping time was one hour and 40 minutes Recovery measurements were taken from the pumping well and the observation wells for about 165 minutes following termination of pumping

Water produced from the test was pumped directly into the French Limited Lagoon

## INTERPRETATION:

The observation well REI-10-3, located 80 88 feet from well REI-10-2, showed a very slight response due to pumping well REI-10-2 The drawdown was insufficient to match with a Theis or Boulton type curve The drawdown in well REI-10-4, located 53 77 feet from well REI-10-2, was slightly greater and sufficient to allow for a satisfactory match with a Boulton Delayed Yield type curve The drawdown data are attached and the results of this analysis are provided in Figure A2-1

The transmissivity calculated using the Boulton Delayed Yield type curve with $r/B = 2.0$ is 142 gpd/ft and the average hydraulic conductivity is determined to be $4.8 \times 10^{-4}$ cm/sec. The estimated storage coefficient from the early response is 0 00086 The results of this test are thought to be poor and only provide order-of-magnitude estimates In order to apply the Boulton type curve, it was necessary to assume that the pumping rate was constant during the entire pumping period. However, the actual pumping rate declined after about 35 minutes into the test because of the rapid drawdown to pump level

The u value at the radius of the observation wells was too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers for variable pumping rates The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where r is the radial distance between the pumped well and the observation well (feet),
S is the storage coefficient (dimensionless), and
T is transmissivity ($feet^2$/day)
t is the time since pumping started (days)

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The "u" value at well REI-10-4 at the end of pumping well REI-10-2 was 0 50 using the transmissivity and storage coefficients from the Boulton Delayed Yield analysis in Figure A2-1. The semi-log technique would be applicable to the pumped well, but the pumped well drawdown response was found to be highly influenced by well bore storage

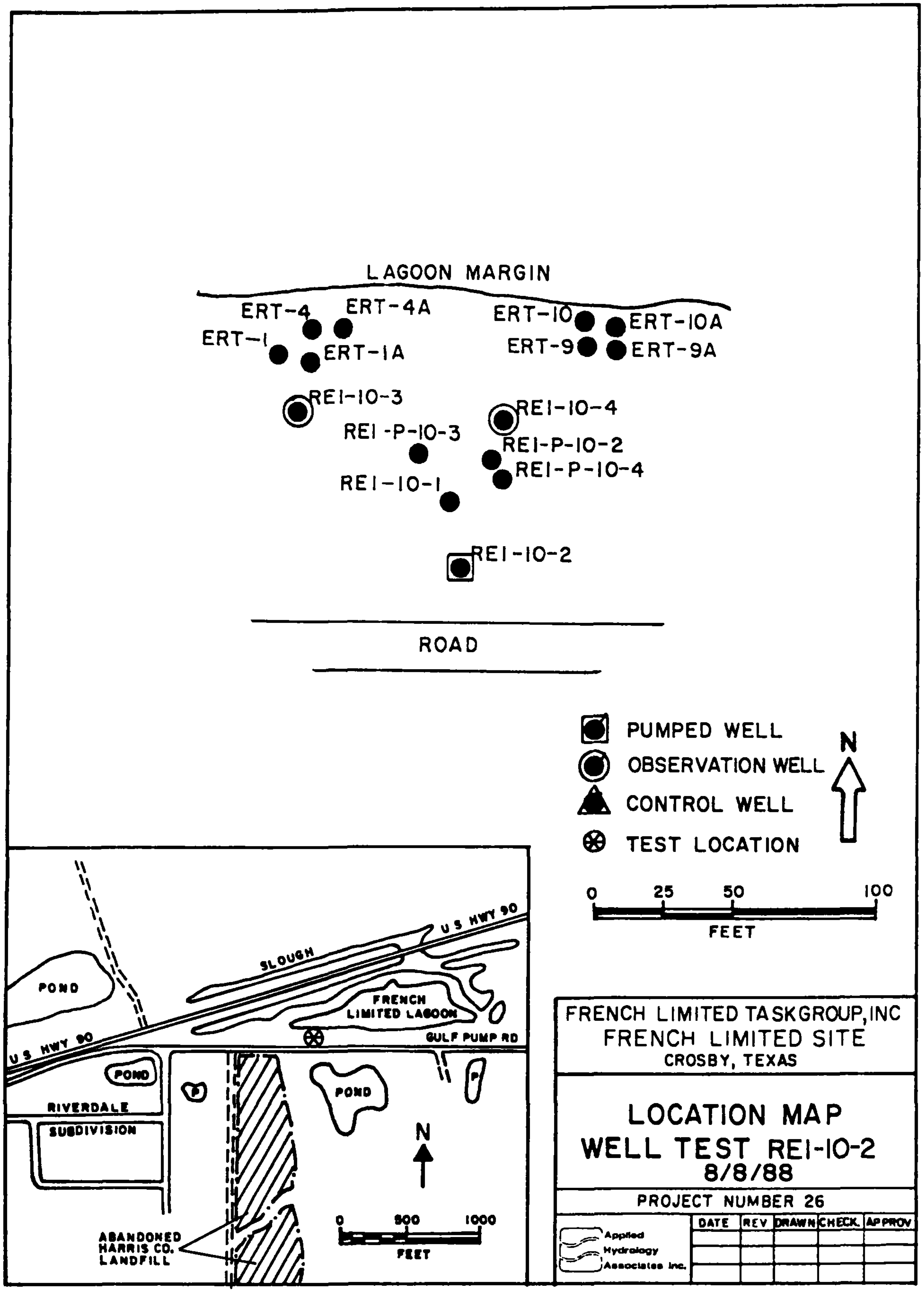
Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2 1 and shown below

tc > 0 6(16-1)/( 672/34 01*) = 455 5 minutes

* drawdown at the last measurement in the pumping period, 99 minutes after the start of pumping rather than at time tc

Drawdown values for the pumped well are included in the attached data sheet Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data Well bore effects had a significant influence on the entire portion of the response data Thus the semi-log analysis technique could not be used to provide an estimate of the transmissivity from the drawdown data from the pumped well Likewise, since tc is greater than 455 minutes, the recovery data points are also subject to significant well bore storage influences.

023830


LAGOON MARGIN
ERT-4
ERT-4A
ERT-10
ERT-10A
ERT-1
ERT-1A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI-P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0
25
50
100
FEET
POND
SLOUGH
U S HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD
RIVERDALE
SUBDIVISION
ABANDONED HARRIS CO. LANDFILL
0
500
1000
FEET
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST REI-10-2
8/8/88
PROJECT NUMBER 26
Applied Hydrology Associates Inc.
DATE
REV
DRAWN
CHECK.
APPROV

0238·)1

**RESOURCE ENGINEERING**
SUBSURFACE EXPLORATION



# LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-2

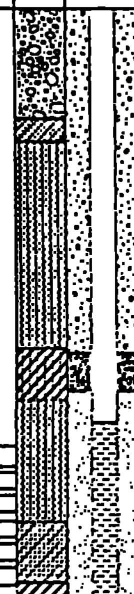
Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14  Boring No.: 10-2
Logged By: S. L. Baird
Approved By:
Drilled By: GCC

DRILLING AND SAMPLING INFORMATION
Date Started: 8/8/86  Date Completed: 8/8/86
Method: MR  Total Depth: 48.0 FEET

WELL COMPLETION INFORMATION
Screen Dia.: 4"  Length: 13.75'
Slot Size: 0.010"  Type: PVC
Casing Dia.: 4"  Length: 36.61

SURFACE ELEVATION 11.90

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SAND AND GRAVEL | 2.9 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | .9 | | | | | | |
| | SILTY SAND | -16.1 | | | | | | |
| 20 | | | | | | | | |
| 30 | SILTY CLAY | -20.1 | | | | | | |
| | SILTY SAND, gray green, strong odor, wet | -30.1 | 1 | SS | 67 | | | |
| 40 | | | 2 | SS | 40 | | | |
| | | | 3 | SS | 80 | | | |
| | SLIGHTLY CLAYEY SAND, gray with yellowish brown stain, some lignite chips | -35.1 | 4 | SS | 47 | | | |
| | | | 5 | SS | 27 | | | |
| | SILTY CLAY | -36.1 | 6 | SS | 67 | | | |
| 50 | | | 7 | SS | 100 | | | |



TD 48.0 BORING (8") DRILLED TO 36'. CONTINUOUSLY SAMPLED IN 3-7/8" BORING TO 49.5. UPPER HOLE COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. ELECTRIC LOGGED. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL GROUTED TO SURFACE WITH CEMENT/ BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED.

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023802

# RESOURCE ENGINEERING

SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-3

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-3
Logged By: S. L. Baird
Approved By:
Drilled By: SWL

DRILLING AND SAMPLING INFORMATION

Date Started: 7/27/86 Date Completed: 7/27/86
Method: MR Total Depth: 48.0 FEET

WELL COMPLETION INFORMATION

Screen Dia.: 4" Length: 10.30'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 39.66

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 13.80 | | | | | | | |
| 0 | SURFACE FILL AND GRAVEL | 10.7 | | | | | | |
| | SAND AND GRAVEL | 4.3 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | 2.6 | | | | | | |
| | SILTY SAND | -18.6 | | | | | | |
| 30 | SANDY SILT/CLAYEY SILT | -24.2 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.7 | | | | | | |
| | VERY SILTY CLAY, reddish brown | -34.2 | 1 | SS | 53 | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE. 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURREY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

n^~812

# RESOURCE ENGINEERING
SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-4

Client FRENCH LTD. TASK GROUP
Project Name French Ltd. 1986 F.I.
Project Location Crosby, Texas
Job No. 275-14 Boring No. 10-4
Logged By S. L. Baird
Approved By
Drilled By SWL

DRILLING AND SAMPLING INFORMATION
Date Started 7/28/86 Date Completed 7/28/86
Method MR Total Depth 48.0 FEET

WELL COMPLETION INFORMATION
Screen Dia. 4" Length 12.80'
Slot Size 0.010" Type PVC
Casing Dia. 4" Length 36.99

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 14.40 | | | | | | | |
| 0 | SURFACE FILL, rubber | 8.4 | | | | | | |
| | SAND AND GRAVEL | 5.9 | | | | | | |
| 10 | CLAYEY SAND | 1.9 | | | | | | |
| 20 | SILTY SAND | -14.1 | | | | | | |
| 30 | SANDY SILT | -7.1 | | | | | | |
| | CLAYEY SILT | -20.6 | | | | | | |
| | SLIGHTLY SILTY CLAY | -22.6 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.6 | | | | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48.0'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023804

STEP DRAWDOWN TEST - WELL REI-10-2

Saturated Thickness 42 11 feet Date 8/8/88

static water level 5 89 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti | Adjusted time min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0 00 | 5 89 | 0 00 | 0 00 | | 0 00 | 0 00 | | |
| 1 00 | 8 08 | 2 19 | 2 14 | | 1 00 | 2 57 | | |
| 2 50 | 9 50 | 3 61 | 3 46 | | 2 50 | 4 16 | | |
| 4 50 | 12 17 | 6 28 | 5 81 | | 4 50 | 7 00 | | |
| 6 00 | 13 63 | 7 74 | 7 02 | | 6 00 | 8 46 | | |
| 7 33 | 15 39 | 9 50 | 8 43 | | 7 33 | 10 16 | | |
| 9 00 | 17 29 | 11 40 | 9 86 | | 9 00 | 11 88 | | |
| 11 00 | 19 33 | 13 44 | 11 30 | | 11 00 | 13 61 | | |
| 13 33 | 21 13 | 15 24 | 12 48 | | 13 33 | 15 04 | | |
| 15 17 | 22 58 | 16 69 | 13 38 | | 15 17 | 16 13 | | |
| 16 50 | 23 75 | 17 86 | 14 07 | | 16 50 | 16 95 | | |
| 20 00 | 26 58 | 20 69 | 15 61 | | 20 00 | 18 81 | | |
| 22 50 | 28 00 | 22 11 | 16 31 | | 22 50 | 19 65 | | |
| 27 50 | 30 88 | 24 99 | 17 57 | | 27 50 | 21 17 | | |
| 32 17 | 33 29 | 27 40 | 18 49 | | 32 17 | 22 27 | | |
| 36 50 | 33 75 | 27 86 | 18 64 | 2 00 | 118 95 | 31 60 | | |
| 39 00 | 33 54 | 27 65 | 18 57 | 4 50 | 93 88 | 31 48 | | |
| 40 00 | 34 75 | 28 86 | 18 97 | 5 50 | 89 66 | 32 15 | | |
| 41 50 | 34 88 | 28 99 | 19 01 | 7 00 | 85 60 | 32 22 | | |
| 43 00 | 34 96 | 29 07 | 19 04 | 8 50 | 83 15 | 32 26 | | |
| 45 00 | 35 10 | 29 21 | 19 08 | 10 50 | 81 34 | 32 34 | | |
| 50 00 | 35 70 | 29 81 | 19 26 | 15 50 | 80 51 | 32 64 | | |
| 55 00 | 36 40 | 30 51 | 19 46 | 20 50 | 82 17 | 32 98 | | |
| 62 50 | 37 60 | 31 71 | 19 77 | 28 00 | 86 64 | 33 51 | | |
| 67 00 | 38 00 | 32 11 | 19 87 | 32 50 | 89 93 | 33 67 | | |
| 72 00 | 38 50 | 32 61 | 19 98 | 37 50 | 93 88 | 33 87 | | |
| 77 00 | 38 80 | 32 91 | 20 05 | 42 50 | 98 06 | 33 98 | | |
| 83 00 | 39 25 | 33 36 | 20 15 | 48 50 | 103 27 | 34 15 | | |
| 89 00 | 39 57 | 33 68 | 20 21 | 54.50 | 108 65 | 34 26 | | |
| 98 00 | 39 87 | 33 98 | 20 27 | 63 50 | 116 92 | 34 36 | | |
| 99 00 | 39 90 | 34 01 | 20 28 | 64 50 | 117 85 | 34 37 | | |
| 105 00 | 39 20 | 33 31 | 20.14 | 5 00 | 1028 87 | 34 13 | 5 00 | 21 00 |
| 106 50 | 38 45 | 32 56 | 19 97 | 6 50 | 569.99 | 33 85 | 6 50 | 16 38 |
| 107 00 | 38 00 | 32 11 | 19 87 | 7 00 | 483 34 | 33 67 | 7 00 | 15 29 |
| 107 63 | 37 50 | 31 61 | 19 75 | 7 63 | 399 13 | 33 47 | 7 63 | 14 10 |
| 108 17 | 37 00 | 31 11 | 19 62 | 8 17 | 344 03 | 33 25 | 8 17 | 13 24 |
| 108 80 | 36 50 | 30 61 | 19 48 | 8 80 | 292 30 | 33 02 | 8 80 | 12 36 |
| 109 40 | 36 00 | 30.11 | 19 35 | 9 40 | 253 35 | 32 79 | 9 40 | 11 64 |
| 110 00 | 35 50 | 29 61 | 19 20 | 10 00 | 221 73 | 32 54 | 10 00 | 11 00 |

023805

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 110 68 | 35.00 | 29 11 | 19 05 | 10 68 | 192 50 | 32 29 | 10 68 | 10 36 |
| 112 00 | 34 00 | 28 11 | 18 73 | 12 00 | 150 50 | 31 74 | 12 00 | 9 33 |
| 113 43 | 33 00 | 27 11 | 18 38 | 13 43 | 118 93 | 31 16 | 13 43 | 8 44 |
| 114 80 | 32 00 | 26 11 | 18 02 | 14.80 | 97 44 | 30 53 | 14 80 | 7 76 |
| 116 47 | 31 00 | 25 11 | 17 62 | 16 47 | 78 50 | 29 87 | 16 47 | 7 07 |
| 118 20 | 30 00 | 24 11 | 17 21 | 18 20 | 64 32 | 29 17 | 18 20 | 6 49 |
| 119 97 | 29 00 | 23 11 | 16 77 | 19 97 | 53 65 | 28 42 | 19 97 | 6 01 |
| 121 87 | 28 00 | 22 11 | 16 31 | 21 87 | 45 04 | 27 64 | 21 87 | 5 57 |
| 123 97 | 27 00 | 21 11 | 15 82 | 23 97 | 37 89 | 26 81 | 23 97 | 5 17 |
| 126 23 | 26 00 | 20 11 | 15 31 | 26 23 | 32 06 | 25 95 | 26 23 | 4 81 |
| 128 63 | 25 00 | 19 11 | 14 77 | 28 63 | 27 36 | 25 04 | 28 63 | 4 49 |
| 131 15 | 24 00 | 18 11 | 14 22 | 31 15 | 23 56 | 24 09 | 31 15 | 4 21 |
| 133 77 | 23 00 | 17 11 | 13 63 | 33 77 | 20 49 | 23 11 | 33 77 | 3 96 |
| 136 33 | 22 00 | 16 11 | 13 03 | 36 33 | 18 10 | 22 08 | 36 33 | 3 75 |
| 139 90 | 21 00 | 15 11 | 12 40 | 39 90 | 15 50 | 21 02 | 39 90 | 3 51 |
| 143 02 | 20 00 | 14 11 | 11 75 | 43 02 | 13 74 | 19 91 | 43 02 | 3 32 |
| 146 53 | 19 00 | 13 11 | 11 07 | 46 53 | 12 14 | 18 76 | 46 53 | 3 15 |
| 150 37 | 18 00 | 12 11 | 10 37 | 50 37 | 10 76 | 17 57 | 50 37 | 2 99 |
| 154 53 | 17 00 | 11 11 | 9 64 | 54 53 | 9 57 | 16 35 | 54 53 | 2 83 |
| 164 22 | 15 00 | 9 11 | 8 12 | 64 22 | 7 60 | 13 77 | 64 22 | 2 56 |
| 176 40 | 13 00 | 7 11 | 6 51 | 76 40 | 6 05 | 11 03 | 76 40 | 2 31 |
| 192 50 | 11 00 | 5 11 | 4 80 | 92 50 | 4 80 | 8 14 | 92 50 | 2 08 |
| 215 00 | 9 00 | 3 11 | 3 00 | 115 00 | 3 80 | 5 08 | 115 00 | 1 87 |
| 266 08 | 7 00 | 1 11 | 1 10 | 166 08 | 2 71 | 1 86 | 166 08 | 1 60 |
| 270 42 | 6 86 | 0 97 | 0 96 | 170 42 | 2 66 | 1 63 | 170 42 | 1 59 |

023806

OBSERVATION WELL - REI-10-3

STEP DRAWDOWN TEST OF WELL REI-10-2

Saturated Thickness 42 5 Date 8/8/88

static water level 5 5

| TIME-t | DEPTH | DRAWDOWN | ADJUSTED DRAWDOWN | RECOVERY TIME-t' | t/t' |
|---|---|---|---|---|---|
| min | ft | ft | ft | min | |
| 0 00 | 5 50 | 0 00 | 0 00 | | |
| 1 00 | 5 50 | 0 00 | 0 00 | | |
| 2 00 | 5 50 | 0 00 | 0 00 | | |
| 3 00 | 5 50 | 0 00 | 0 00 | | |
| 4 00 | 5 50 | 0 00 | 0 00 | | |
| 5 00 | 5 50 | 0 00 | 0 00 | | |
| 6 00 | 5 50 | 0 00 | 0 00 | | |
| 7 00 | 5 50 | 0 00 | 0 00 | | |
| 8 00 | 5 50 | 0 00 | 0 00 | | |
| 9 00 | 5 50 | 0 00 | 0 00 | | |
| 10 00 | 5 50 | 0 00 | 0 00 | | |
| 11 00 | 5 50 | 0 00 | 0 00 | | |
| 12 00 | 5 50 | 0 00 | 0 00 | | |
| 13 00 | 5 50 | 0 00 | 0 00 | | |
| 14 00 | 5 50 | 0 00 | 0 00 | | |
| 15 00 | 5 50 | 0 00 | 0 00 | | |
| 20 00 | 5 50 | 0 00 | 0 00 | | |
| 25 00 | 5 50 | 0 00 | 0 00 | | |
| 30 00 | 5 51 | 0 01 | 0 01 | | |
| 35 00 | 5 51 | 0 01 | 0 01 | | |
| 40 00 | 5 51 | 0 01 | 0 01 | | |
| 45 00 | 5 51 | 0 01 | 0 01 | | |
| 50 00 | 5 51 | 0 01 | 0 01 | | |
| 55.00 | 5 51 | 0 01 | 0 01 | | |
| 60 00 | 5 51 | 0 01 | 0 01 | | |
| 65 00 | 5 50 | 0 00 | 0 00 | | |
| 70 00 | 5 50 | 0 00 | 0 00 | | |
| 75 00 | 5 50 | 0 00 | 0 00 | | |
| 80 00 | 5 50 | 0 00 | 0 00 | | |
| 85 00 | 5 50 | 0 00 | 0 00 | | |
| 94 00 | 5 50 | 0 00 | 0 00 | | |
| 100 00 | | | | | |
| 101 00 | 5 50 | 0.00 | 0 00 | 1 00 | 101 00 |
| 102 00 | 5 50 | 0 00 | 0 00 | 2 00 | 51 00 |
| 103 00 | 5 50 | 0.00 | 0 00 | 3 00 | 34 33 |
| 104 00 | 5 50 | 0 00 | 0 00 | 4 00 | 26 00 |
| 105 00 | 5 50 | 0 00 | 0 00 | 5 00 | 21 00 |

| | | | | | |
|---|---|---|---|---|---|
| 110 00 | 5 50 | 0 00 | 0 00 | 10 00 | 11 00 |
| 115 00 | 5 50 | 0 00 | 0 00 | 15 00 | 7 67 |
| 120 00 | 5 50 | 0 00 | 0 00 | 20 00 | 6 00 |
| 125 00 | 5 49 | -0 01 | -0 01 | 25 00 | 5 00 |
| 130 00 | 5 49 | -0 01 | -0 01 | 30 00 | 4 33 |
| 135 00 | 5 49 | -0 01 | -0 01 | 35 00 | 3 86 |
| 140 00 | 5 49 | -0 01 | -0 01 | 40 00 | 3 50 |
| 145 00 | 5 50 | 0 00 | 0 00 | 45 00 | 3 22 |
| 150 00 | 5 50 | 0 00 | 0 00 | 50 00 | 3 00 |
| 155 00 | 5 49 | -0 01 | -0 01 | 55 00 | 2 82 |
| 160 00 | 5 49 | -0 01 | -0 01 | 60 00 | 2 67 |
| 170 00 | 5 49 | -0 01 | -0 01 | 70 00 | 2 43 |
| 180 00 | 5 49 | -0 01 | -0 01 | 80 00 | 2 25 |
| 190 00 | 5 48 | -0 02 | -0 02 | 90 00 | 2 11 |
| 200 00 | 5 48 | -0 02 | -0 02 | 100 00 | 2 00 |
| 230 00 | 5 47 | -0 03 | -0 03 | 130 00 | 1 77 |
| 260 00 | 5 49 | -0 01 | -0 01 | 160 00 | 1 63 |

OBSERVATION WELL - REI-10-4

STEP DRAWDOWN TEST OF WELL REI-10-2

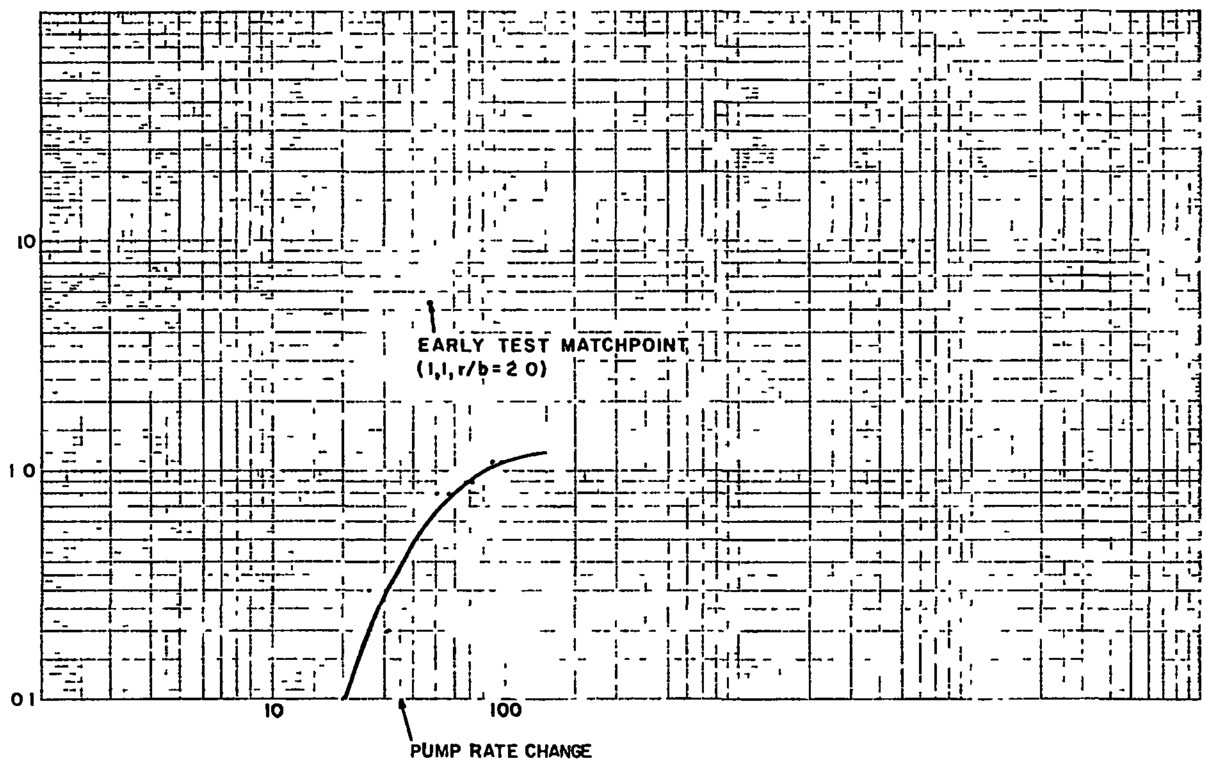
Saturated Thickness 42 21 Date 8/8/88

static water level 5 79

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0 00 | 5 79 | 0 00 | 0 00 | | |
| 1 00 | 5 79 | 0 00 | 0 00 | | |
| 2 00 | 5 79 | 0 00 | 0 00 | | |
| 3 00 | 5 79 | 0 00 | 0 00 | | |
| 4 00 | 5 79 | 0 00 | 0 00 | | |
| 5 00 | 5 79 | 0 00 | 0 00 | | |
| 6 00 | 5 79 | 0 00 | 0 00 | | |
| 7 00 | 5 79 | 0 00 | 0 00 | | |
| 8 00 | 5 79 | 0 00 | 0 00 | | |
| 9 00 | 5 79 | 0 00 | 0 00 | | |
| 10 00 | 5 79 | 0 00 | 0 00 | | |
| 11 00 | 5 79 | 0 00 | 0 00 | | |
| 12 00 | 5 79 | 0 00 | 0 00 | | |
| 13 00 | 5 79 | 0 00 | 0 00 | | |
| 14 00 | 5 79 | 0 00 | 0 00 | | |
| 15 00 | 5 79 | 0 00 | 0 00 | | |
| 20 00 | 5 80 | 0 01 | 0 01 | | |
| 25 00 | 5 82 | 0 03 | 0 03 | | |
| 30 00 | 5 82 | 0 03 | 0 03 | | |
| 35 00 | 5 83 | 0 04 | 0 04 | | |
| 40 00 | 5 84 | 0 05 | 0 05 | | |
| 45 00 | 5 86 | 0 07 | 0 07 | | |
| 50 00 | 5 87 | 0 08 | 0.08 | | |
| 55 00 | 5 87 | 0 08 | 0 08 | | |
| 60 00 | 5 88 | 0 09 | 0 09 | | |
| 65 00 | 5 88 | 0 09 | 0 09 | | |
| 70 00 | 5 88 | 0 09 | 0 09 | | |
| 75 00 | 5 88 | 0 09 | 0 09 | | |
| 80 00 | 5 90 | 0 11 | 0 11 | | |
| 85 00 | 5 90 | 0 11 | 0 11 | | |
| 94 00 | 5 90 | 0 11 | 0 11 | | |
| 100 00 | | | | | |
| 101 00 | 5 90 | 0 11 | 0 11 | 1 00 | 101 00 |
| 102 00 | 5 90 | 0 11 | 0 11 | 2.00 | 51 00 |
| 103 00 | 5 90 | 0 11 | 0 11 | 3 00 | 34 33 |
| 104 00 | 5 90 | 0 11 | 0 11 | 4 00 | 26 00 |
| 105 00 | 5 90 | 0 11 | 0 11 | 5 00 | 21 00 |

023819

| | | | | | |
|---|---|---|---|---|---|
| 110 00 | 5 90 | 0 11 | 0 11 | 10 00 | 11 00 |
| 115 00 | 5 90 | 0 11 | 0 11 | 15 00 | 7 67 |
| 120 00 | 5 90 | 0 11 | 0 11 | 20 00 | 6.00 |
| 125 00 | 5 88 | 0 09 | 0 09 | 25 00 | 5 00 |
| 130 00 | 5 88 | 0 09 | 0 09 | 30 00 | 4 33 |
| 135 00 | 5 88 | 0 09 | 0 09 | 35 00 | 3 86 |
| 140 00 | 5 87 | 0 08 | 0 08 | 40 00 | 3 50 |
| 145 00 | 5 87 | 0 08 | 0 08 | 45 00 | 3 22 |
| 150 00 | 5 86 | 0 07 | 0 07 | 50 00 | 3 00 |
| 155 00 | 5 85 | 0 06 | 0 06 | 55 00 | 2 82 |
| 160 00 | 5 84 | 0 05 | 0 05 | 60 00 | 2 67 |
| 170 00 | 5 82 | 0 03 | 0 03 | 70 00 | 2 43 |
| 180 00 | 5 81 | 0 02 | 0 02 | 80 00 | 2 25 |
| 190 00 | 5 80 | 0 01 | 0 01 | 90 00 | 2 11 |
| 200 00 | 5 80 | 0 01 | 0 01 | 100 00 | 2 00 |
| 230 00 | 5 77 | -0 02 | -0 02 | 130 00 | 1 77 |
| 260 00 | 5 74 | -0 05 | -0 05 | 160 00 | 1 63 |




OBSERVATION WELL REI-10-4 ANALYSIS

Q = 0 67 gpm = 964 8 gpd

$$T = \frac{10Q}{4\pi S} = \frac{964\ 8\ gpd}{4\pi(0\ 54\ ft)} = 142\ gpd/ft$$

$$Se = \frac{4Tt}{r^2} = \frac{4(\ 0132\ ft/min)(47\ min)}{(53\ 77\ ft)^2}$$

Se = 00086

B-169

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A2-1

BOULTON DELAYED YIELD ANALYSIS

PUMPED WELL REI-10-2
OBSERVATION WELL REI-10-4
DATE(S) August 8, 1988

| PROJECT No | DATE | REVISION |
|---|---|---|

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023810

# FRENCH LIMITED SITE
# AQUIFER TESTING PROGRAM

DATE OF TEST August 9, 1988

PUMPED WELL REI-10-3

OBSERVATION WELLS REI-10-2, radial distance 80 88 feet,
REI-10-4, radial distance 72 96 feet and
ERT-1, radial distance 20 27 feet

CONTROL WELLS none

## BACKGROUND AND DESCRIPTION OF TEST

The original work plan included testing well REI-10-3. In the review of the work plan, Ms Kathleen O'Reiley of Region VI of the U S EPA expressed concern that the REI-10-3 well may not be representative because of the low transmissivity associated with the single well recovery analysis of the short term (15 minute) test performed on May 26, 1988 It appeared that the low transmissivity calculated from the short term single well test results could have been due to well inefficiency as suggested by the low pumping rate and large drawdown in this well Such well inefficiency would also cause well bore storage effects to be significant for unconfined conditions Well bore effects could also contribute to the lower transmissivity estimate for this short term test

It was agreed by personnel from Region VI of the U S EPA that contractors to the French Limited Task Group, Inc would perform a step drawdown or variable rate test on wells REI-10-2, REI-10-3 and REI-10-4 in order to select a well for a six- to eight-hour pumping test The contractors performing the pump test, Applied Hydrology Associates, Inc (AHA) and ERT, proposed to pump each well for 30 minutes at 1.5 gpm, then raise the pumping rate to 2 5 gpm for 30 minutes and then pump for an additional 30 minutes at a higher rate if drawdown had not approached the pumping level It was agreed that the test would be terminated if drawdown to the pump caused the pumping rate to drop significantly Recovery measurements would be taken following termination of pumping

A variable rate test was performed on well REI-10-3 by AHA and ERT personnel Lithologic and well completion logs and an illustration of the location of the pumped well, REI-10-3, and the observation wells, ERT-1, REI-10-2 and REI-10-4, precede the aquifer test data which follow

Prior to pumping the well, the depth to static water level below the top of casing in the pumped well and the observation wells were measured using an electronic well sounder with accuracy to .01 feet. Well REI-10-3 was pumped with a submersible pump and water level measurements were taken with an electronic sounder on the pumped well and on wells REI-10-2, REI-10-4 and ERT-1

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions·

$$s' = s - s^2/2Ho$$

where $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

The attached data sheets present the measurements for the pumped well and the observation wells during the pump test and recovery period The data sheets include the observed drawdowns and the corrected drawdowns

Well REI-10-3 was pumped at 0 5 gpm for the first 30 minutes The flow rate as measured by an in-line Rotometer was verified with bucket and stop watch measurements After 30 minutes, the pumping rate was raised to 1 0 gpm The one gallon per minute rate could be sustained for only 12 minutes until drawdown reached the pump level Pumping was terminated at that point. The total pumping time was 42 minutes Recovery measurements were taken in the pumping well for about 470 minutes following termination of pumping Recovery measurements were also taken on the nearest well, ERT-1, for about 270 minutes following termination of pumping

Water produced from the test was pumped directly into the French Limited Lagoon

INTERPRETATION

The observation wells ERT-1, REI-10-3 and REI-10-4 showed a very slight response due to pumping well REI-10-3 The water levels in the observation wells dropped during the latter portion of the pumping period but the drawdown response was too slight to allow for a satisfactory match with a Theis curve or a Boulton Delayed Yield curve The drawdown data sheets are attached

The u value at the radius of the observation wells was too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers for variable pumping rates The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0 01

where r is the radial distance between the pumped well and the observation well (feet),
S is the storage coefficient (dimensionless),
T is transmissivity ($\text{feet}^2$/day), and
t is the time since pumping started (days)

The parameter "u" is less than 0 01 when the radial distance to the observation well is small or when the time of pumping is long The "u" value at the end of pumping at the nearest observation well ERT-1, located 20.27 feet from the pumped well, was 0 17 using the transmissivity and storage coefficients from the Boulton Delayed Yield analysis in Figure A2-

1 The semi-log technique would be applicable to the pumped well, but the pumped well drawdown response was found to be highly influenced by well bore storage.

Well bore storage effects were significant for the entire pumping period The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2 1 and shown below.

tc > 0 6(16-1)/( 643/24 18*) = 338 minutes

* drawdown at the last measurement in the pumping period, 42 minutes after the start of pumping rather than at time tc

Drawdown and recovery values for the pumped well are included in the attached data sheet Well bore effects had a significant influence on the entire portion of the response data. Thus the semi-log analysis technique could not be used to provide an estimate of the transmissivity from the drawdown data from the pumped well Likewise, since tc is greater than 338 minutes, only the last four recovery data points are in the range where well bore influences are minimal

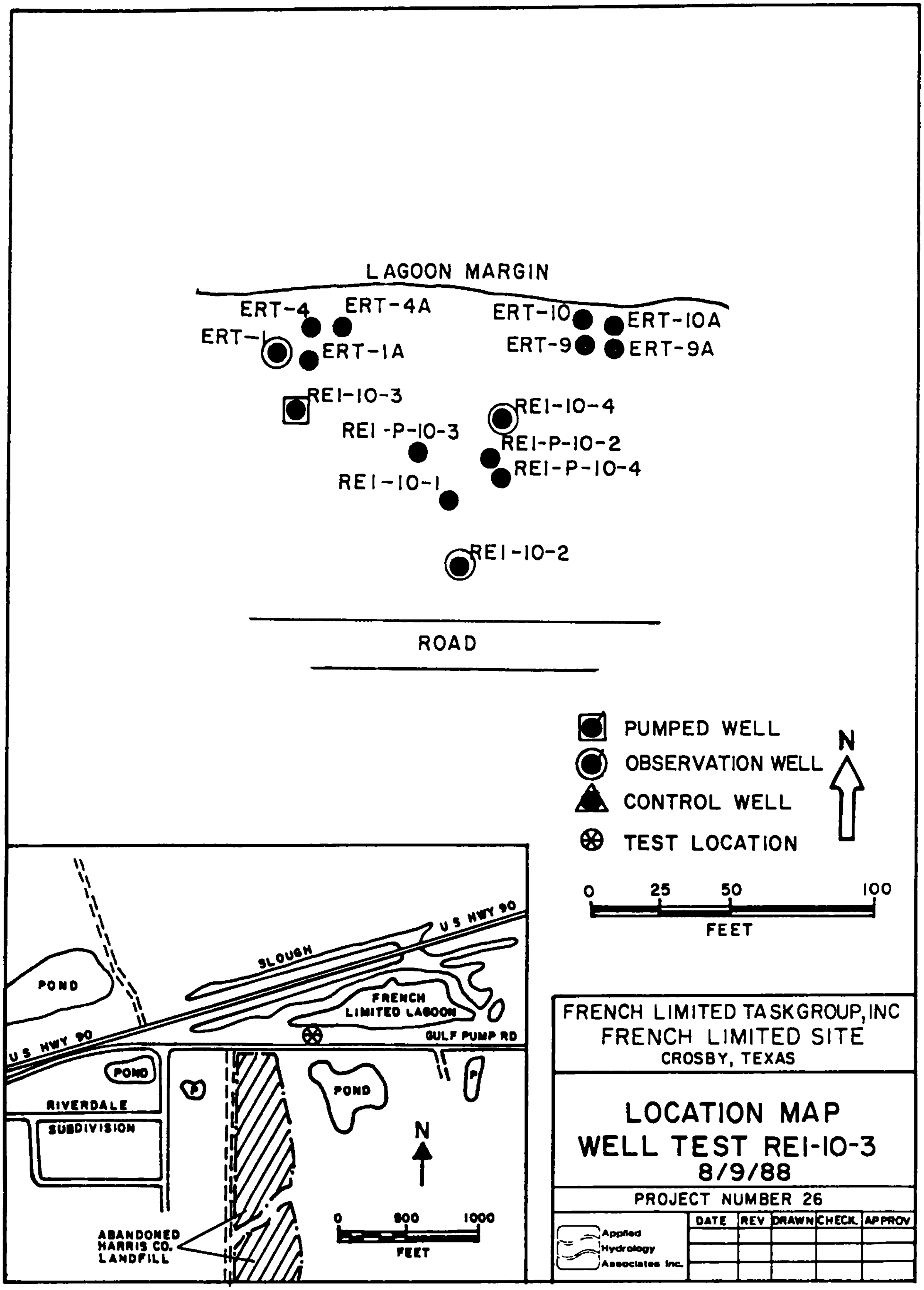
A Theis (1935) recovery analysis of the last four recovery points for the production well REI-10-3 was performed The adjusted residual drawdown data from the recovery period for the pumped well were analyzed using the nonproprietary pump test program RECOVERY (Beljin, 1986) available from the International Groundwater Modeling Center The technique is appropriate for analyses of measurements in the pumped well when the dimensionless parameter "u" is less than 0 01 and the data are not influenced by well bore storage The solution involves fitting a straight line to a plot of adjusted residual drawdown on an arithmetic scale against the ratio t/t' (where t is time since pumping started, and t' is time since pumping stopped) on a log scale

The change in drawdown over one log cycle of time is used to calculate transmissivity. The RECOVERY program allows the user to interactively specify which data are to be used in fitting the straight line

Using the last four data points from the recovery period plus the additional point of zero residual drawdown at t/t' = 1, and an average pumping rate of 0 643 gpm, the resulting transmissivity estimate is four gpd/ft The average hydraulic conductivity was determined to be 1 $9 \times 10^{-5}$ cm/sec The storage coefficient could not be determined from the single well test. The results of this analysis are attached

The results are thought to be fair and provide only order-of-magnitude estimates because of the variable pumping rate and because only four data points over a vary narrow range of log t/t' were considered to be satisfactory for use in the interpretation. Nevertheless, the recovery data are less sensitive to the variable pumping rate and the coefficient of determination of the curve fit to the data was 0 989 indicating a very good fit Consequently, the results of this recovery analysis are thought to provide a valid characterization of the transmissivity of the upper alluvial zone in the vicinity of well REI-10-3

023814


LAGOON MARGIN
ERT-4
ERT-4A
ERT-1
ERT-1A
ERT-10
ERT-10A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI-P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0
25
50
100
FEET
U S HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD
U S HWY 90
POND
RIVERDALE
SUBDIVISION
P
POND
P
N
0
500
1000
FEET
ABANDONED HARRIS CO. LANDFILL
FRENCH LIMITED TASKGROUP, INC
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST REI-10-3
8/9/88
PROJECT NUMBER 26
DATE
REV
DRAWN
CHECK
APPROV
Applied Hydrology Associates Inc.

00018

# RESOURCE ENGINEERING
SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-3

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-3
Logged By: S. L. Baird
Approved By:
Drilled By: SWL

DRILLING AND SAMPLING INFORMATION
Date Started: 7/27/86 Date Completed: 7/27/86
Method: MR Total Depth: 48.0 FEET

WELL COMPLETION INFORMATION
Screen Dia.: 4" Length: 10.30'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 39.66

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 13.80 | | | | | | | |
| 0 | SURFACE FILL AND GRAVEL | 10.7 | | | | | | |
| | SAND AND GRAVEL | 4.3 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | 2.6 | | | | | | |
| | SILTY SAND | -18.6 | | | | | | |
| | SANDY SILT/CLAYEY SILT | -24.2 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.7 | | | | | | |
| | VERY SILTY CLAY, reddish brown | -34.2 | 1 | SS | 53 | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURREY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

Depth scale: 0, 10, 20, 30, 40, 50

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION



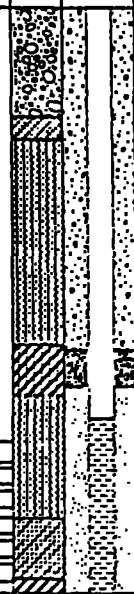
# LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-2

Client FRENCH LTD. TASK GROUP
Project Name French Ltd. 1986 F.I.
Project Location Crosby, Texas
Job No. 275-14 Boring No. 10-2
Logged By S. L. Baird
Approved By
Drilled By GCC

DRILLING AND SAMPLING INFORMATION
Date Started 8/8/86 Date Completed 8/8/86
Method MR Total Depth 48.0 FEET

WELL COMPLETION INFORMATION
Screen Dia. 4" Length 13.75'
Slot Size 0.010" Type PVC
Casing Dia. 4" Length 36.61

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 11.90 | | | | | | | |
| 0 | SAND AND GRAVEL | 2.9 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | .9 | | | | | | |
| | SILTY SAND | -16.1 | | | | | | |
| 30 | SILTY CLAY | -20.1 | | | | | | |
| | SILTY SAND, gray green, strong odor, wet | | 1 | SS | 67 | | | |
| | | | 2 | SS | 40 | | | |
| 40 | | -30.1 | 3 | SS | 80 | | | |
| | SLIGHTLY CLAYEY SAND, gray with yellowish brown stain, some lignite chips | | 4 | SS | 47 | | | |
| | | | 5 | SS | 27 | | | |
| | SILTY CLAY | -35.1 | 6 | SS | 67 | | | |
| | | -36.1 | 7 | SS | 100 | | | |



TD 48.0 BORING (8") DRILLED TO 36'. CONTINUOUSLY SAMPLED IN 3-7/8" BORING TO 49.5. UPPER HOLE COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. ELECTRIC LOGGED. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE. 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023817

# RESOURCE ENGINEERING
SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-4

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-4
Logged By: S. L. Baird
Approved By:
Drilled By: SWL

**DRILLING AND SAMPLING INFORMATION**
Date Started: 7/28/86 Date Completed: 7/28/86
Method: MR Total Depth: 48.0 FEET

**WELL COMPLETION INFORMATION**
Screen Dia.: 4" Length: 12.80'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 36.99

SURFACE ELEVATION 14.40

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE FILL, rubber | 8.4 | | | | | | |
| | SAND AND GRAVEL | 5.9 | | | | | | |
| 10 | CLAYEY SAND | 1.9 | | | | | | |
| 20 | SILTY SAND | -14.1 | | | | | | |
| 30 | SANDY SILT | -7.1 | | | | | | |
| | CLAYEY SILT | -20.6 | | | | | | |
| | SLIGHTLY SILTY CLAY | -22.6 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.6 | | | | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48.0'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

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ERT

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

Sheet 1 of 1

# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 1

Client French Ltd. Task Group
Project Name Bioremediation
Project Location Crosby, TX
Job No 275-21 MW ERT 1
Logged By SLB
Approved By
Drilled By JS

DRILLING AND SAMPLING INFORMATION
Date Started 3/11/87 Date Completed 3/11/87
Method RW Total Depth 50 feet

WELL COMPLETION INFORMATION
Screen Dia. 4" Length 30 feet
Slot Size 0.010" Type PVC
Casing Dia. 4" Length 20 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLED INTERVALS, HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | |
| 0 | | | | | | | | | |
| 10 | SILTY SAND-gray, medium to fine grain, wet, asorted multicolored fines,odor | | | | | | | | |
| 20 | thin gravel ledge. slight odor, dark gray sludge | | | | | | | | |
| 30 | SANDY CLAY-gray, multicolor gravels washing from above | | | | | | | | |
| | SANDY SILT & SILTY SAND-tan, strong odor | | | | | | | | |
| 40 | | | | | | | | | |
| | VERY SILTY CLAY-gray and white ,odor | | | | | | | | |
| 50 | | | | | | | | | |

FORMATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE,CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CC-CONTINUOUS CORNER
ST - PRESSED SHELBY TUBE CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS AR-AIR ROTARY
CFA - CONTINUOUS FLIGHT AUGERS RW-ROTARY WASH

023819

STEP DRAWDOWN TEST - WELL REI-10-3

Saturated Thicknes 42.68 feet

static water level 5.32 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0 | 5.32 | 0 | 0 | | |
| 1 | 6.67 | 1.35 | 1.328649 | | |
| 1.5 | 7.02 | 1.7 | 1.666143 | | |
| 2 | 7.43 | 2.11 | 2.057843 | | |
| 2.5 | 7.7 | 2.38 | 2.313641 | | |
| 3 | 8.13 | 2.81 | 2.717496 | | |
| 3.5 | 8.4 | 3.08 | 2.968865 | | |
| 4 | 8.7 | 3.38 | 3.246162 | | |
| 4.5 | 8.95 | 3.63 | 3.475631 | | |
| 5 | 9.37 | 4.05 | 3.857843 | | |
| 6 | 10.52 | 5.2 | 4.883223 | | |
| 7 | 11.6 | 6.28 | 5.817975 | | |
| 8 | 12.53 | 7.21 | 6.601001 | | |
| 9.5 | 14.1 | 8.78 | 7.876902 | | |
| 10 | 14.62 | 9.3 | 8.286761 | | |
| 11 | 16.61 | 11.29 | 9.796746 | | |
| 12 | 16.55 | 11.23 | 9.752576 | | |
| 13 | 17.3 | 11.98 | 10.29864 | | |
| 15.5 | 19.52 | 14.2 | 11.83776 | | |
| 16 | 19.84 | 14.52 | 12.05010 | | |
| 18 | 21.25 | 15.93 | 12.95712 | | |
| 19 | 21.4 | 16.08 | 13.05087 | | |
| 20 | 21.88 | 16.56 | 13.34732 | | |
| 22.5 | 22.77 | 17.45 | 13.88272 | | |
| 24 | 23.07 | 17.75 | 14.05901 | | |
| 26 | 23.37 | 18.05 | 14.23319 | | |
| 30 | 25.68 | 20.36 | 15.50374 | | |
| 31 | 26.24 | 20.92 | 15.79293 | | |
| 34 | 28.68 | 23.36 | 16.96719 | | |
| 38 | 30.52 | 25.2 | 17.76044 | | |
| 40 | 31.25 | 25.93 | 18.05318 | | |
| 41 | 30.25 | 24.93 | 17.64901 | | |
| 42 | 29.5 | 24.18 | 17.33051 | | |
| 44.5 | 28.5 | 23.18 | 16.88533 | 2.5 | 17.8 |
| 46 | 28 | 22.68 | 16.65396 | 4 | 11.5 |
| 47.42 | 27.5 | 22.18 | 16.41673 | 5.42 | 8.749077 |
| 48.75 | 27 | 21.68 | 16.17364 | 6.75 | 7.222222 |
| 50.2 | 26.5 | 21.18 | 15.92470 | 8.2 | 6.121951 |
| 51.63 | 26 | 20.68 | 15.66989 | 9.63 | 5.361370 |

| | | | | | |
|---|---|---|---|---|---|
| 53.18 | 25.5 | 20.18 | 15.40923 | 11.18 | 4.756708 |
| 54.78 | 25 | 19.68 | 15.14271 | 12.78 | 4.286384 |
| 56.58 | 24.5 | 19.18 | 14.87034 | 14.58 | 3.880658 |
| 58.45 | 24 | 18.68 | 14.59210 | 16.45 | 3.553191 |
| 60.33 | 23.5 | 18.18 | 14.30801 | 18.33 | 3.291325 |
| 62.37 | 23 | 17.68 | 14.01806 | 20.37 | 3.061855 |
| 64.5 | 22.5 | 17.18 | 13.72226 | 22.5 | 2.866666 |
| 66.57 | 22 | 16.68 | 13.42059 | 24.57 | 2.709401 |
| 69 | 21.5 | 16.18 | 13.11307 | 27 | 2.555555 |
| 71.33 | 21 | 15.68 | 12.79970 | 29.33 | 2.431980 |
| 74.28 | 20.5 | 15.18 | 12.48046 | 32.28 | 2.301115 |
| 77.13 | 20 | 14.68 | 12.15537 | 35.13 | 2.195559 |
| 80.32 | 19.5 | 14.18 | 11.82441 | 38.32 | 2.096033 |
| 83.63 | 19 | 13.68 | 11.48761 | 41.63 | 2.008887 |
| 87.15 | 18.5 | 13.18 | 11.14494 | 45.15 | 1.930232 |
| 91 | 18 | 12.68 | 10.79641 | 49 | 1.857142 |
| 95.05 | 17.5 | 12.18 | 10.44203 | 53.05 | 1.791705 |
| 99.53 | 17 | 11.68 | 10.08179 | 57.53 | 1.730053 |
| 104.33 | 16.5 | 11.18 | 9.715702 | 62.33 | 1.673832 |
| 109.6 | 16 | 10.68 | 9.343748 | 67.6 | 1.621301 |
| 115.25 | 15.5 | 10.18 | 8.965937 | 73.25 | 1.573378 |
| 121.42 | 15 | 9.68 | 8.582268 | 79.42 | 1.528834 |
| 135.7 | 14 | 8.68 | 7.797357 | 93.7 | 1.448239 |
| 152.62 | 13 | 7.68 | 6.989015 | 110.62 | 1.379678 |
| 173.83 | 12 | 6.68 | 6.157244 | 131.83 | 1.318592 |
| 200.38 | 11 | 5.68 | 5.302043 | 158.38 | 1.265184 |
| 281.72 | 9 | 3.68 | 3.521349 | 239.72 | 1.175204 |
| 313 | 8.47 | 3.15 | 3.033757 | 271 | 1.154981 |
| 345.5 | 8.05 | 2.73 | 2.642688 | 303.5 | 1.138385 |
| 375 | 7.67 | 2.35 | 2.285303 | 333 | 1.126126 |
| 411 | 7.33 | 2.01 | 1.962669 | 369 | 1.113821 |
| 435 | 7.16 | 1.84 | 1.800337 | 393 | 1.106870 |
| 515 | 6.66 | 1.34 | 1.318964 | 473 | 1.088794 |

023821

STEP DRAWDOWN TEST - WELL REI-10-3

OBSERVATION WELL REI-10-2

Saturated Thicknes 42.14 feet

static water level 5.86 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0 | 5.86 | 0.00 | 0.00 | | |
| 5 | 5.86 | 0.00 | 0.00 | | |
| 10 | 5.86 | 0.00 | 0.00 | | |
| 15 | 5.86 | 0.00 | 0.00 | | |
| 20 | 5.86 | 0.00 | 0.00 | | |
| 25 | 5.87 | 0.01 | 0.01 | | |
| 30 | 5.87 | 0.01 | 0.01 | | |
| 40 | 5.87 | 0.01 | 0.01 | | |
| 45 | 5.87 | 0.01 | 0.01 | 3.00 | 15.00 |
| 50 | 5.86 | 0.00 | 0.00 | 8.00 | 6.25 |

023872

STEP DRAWDOWN TEST - WELL REI-10-3

OBSERVATION WELL REI-10-4

Saturated Thicknes 42.21 feet

static water level 5.79 feet

| TIME-t | DEPTH | DRAWDOWN | ADJUSTED DRAWDOWN | RECOVERY TIME-t' | t/t' |
|---|---|---|---|---|---|
| min | ft | ft | ft | min | |
| 0 | 5.79 | 0.00 | 0.00 | | |
| 5 | 5.79 | 0.00 | 0.00 | | |
| 10 | 5.79 | 0.00 | 0.00 | | |
| 15 | 5.79 | 0.00 | 0.00 | | |
| 20 | 5.79 | 0.00 | 0.00 | | |
| 25 | 5.8 | 0.01 | 0.01 | | |
| 30 | 5.8 | 0.01 | 0.01 | | |
| 40 | 5.8 | 0.01 | 0.01 | | |
| 50 | 5.79 | 0.00 | 0.00 | 8.00 | 6.25 |

STEP DRAWDOWN TEST - WELL REI-10-3

OBSERVATION WELL ERT-1

Saturated Thicknes 43.34 feet

static water level 6.66 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0 | 6.66 | 0 | 0 | | |
| 5 | 6.66 | 0 | 0 | | |
| 10 | 6.66 | 0 | 0 | | |
| 15 | 6.68 | 0.02 | 0.019995 | | |
| 20 | 6.68 | 0.02 | 0.019995 | | |
| 25 | 6.7 | 0.04 | 0.039981 | | |
| 30 | 6.72 | 0.06 | 0.059958 | | |
| 40 | 6.72 | 0.06 | 0.059958 | | |
| 50 | 6.7 | 0.04 | 0.039981 | 8 | 6.25 |
| 60 | 6.7 | 0.04 | 0.039981 | 18 | 3.333333 |
| 75 | 6.68 | 0.02 | 0.019995 | 33 | 2.272727 |
| 90 | 6.68 | 0.02 | 0.019995 | 48 | 1.875 |
| 120 | 6.68 | 0.02 | 0.019995 | 78 | 1.538461 |
| 150 | 6.67 | 0.01 | 0.009998 | 108 | 1.388888 |
| 180 | 6.67 | 0.01 | 0.009998 | 138 | 1.304347 |
| 210 | 6.66 | 0 | 0 | 168 | 1.25 |
| 285 | 6.63 | -0.03 | -0.03001 | 243 | 1.172839 |
| 315 | 6.63 | -0.03 | -0.03001 | 273 | 1.153846 |

```
********************************************************
*                                                      *
*              program:  Recovery                      *
*              version:  IBM PC 1.0                    *
*                                                      *
*  A PROGRAM FOR PUMP TEST ANALYSIS USING JACOB'S      *
*  FORM OF THEIS EQUATION AND LEAST SQUARES' METHOD.   *
*                                                      *
********************************************************
```

PROJECT......... = FRENCH LIMITED
LOCATION........ = CROSBY, TX
WELL............ = REI 10-3
DATE............ = 8/9/88

STATIC WATER LEVEL   S.W.L.   =  5.32 [ft]
DISCHARGE RATE............... =  .643 [gpm]
DURATION OF PUMPING PERIOD... =  42 [min]

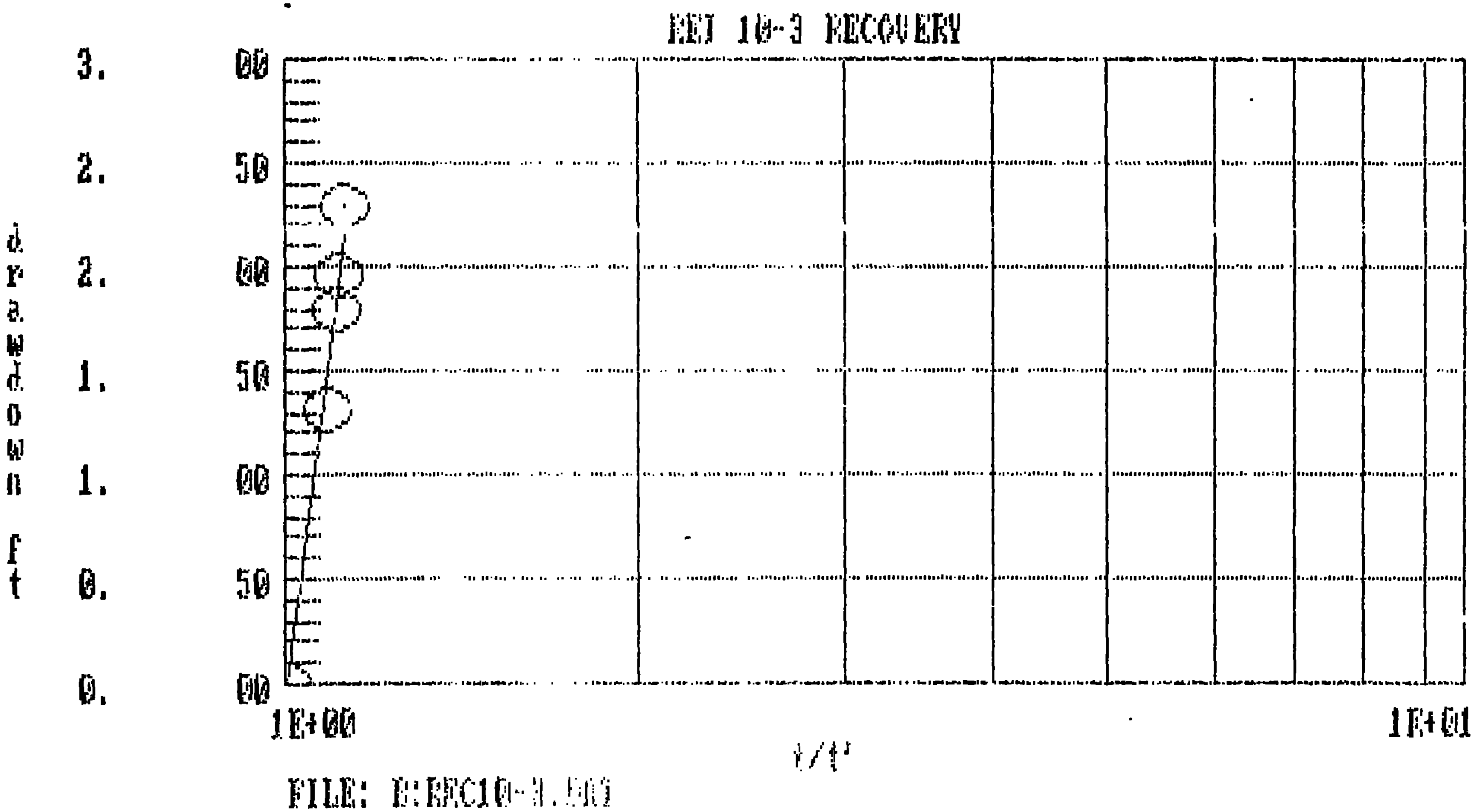
| NO | TIME t'[min] | TIME t [min] | t/t' | DRAWDOWN s'[ft] | DEVIATION |
|---|---|---|---|---|---|
| 1 | 333.00 | 375.00 | 1.13 | 2.285 | +.134E+00 |
| 2 | 369.00 | 411.00 | 1.11 | 1.963 | +.213E-01 |
| 3 | 393.00 | 435.00 | 1.11 | 1.800 | -.226E-01 |
| 4 | 473.00 | 515.00 | 1.09 | 1.319 | -.190E+00 |
| 5 | %10000.00 | %10042.00 | 1.00 | 0.000 | +.287E-01 |
| 6 | %10000.00 | %10042.00 | 1.00 | 0.000 | +.287E-01 |

TRANSMISSIVITY T = .599E-05 [ft2/s]
               T =      4 [gpd/ft]

DATA SEGMENT ANALYZED :
- starting with data pair 1
- ending with data pair 6

DETERMINATION COEFFICENT = .9886292

********************************************************


10-3 RECOVERY
3.00
2.50
2.00
1.50
1.00
0.50
0.00
drawdown ft
1E+00
1E+01
FILE:

B-184

023875

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 5, 1988

PUMPED WELL: REI-10-4

OBSERVATION WELLS: REI-10-2, radial distance 53.77 feet and
REI-10-3, radial distance 72.96 feet

CONTROL WELLS: none

BACKGROUND AND DESCRIPTION OF TEST:

The original work plan included testing well REI-10-3. In the review of the work plan, Ms. Kathleen O'Reiley of Region VI of the U.S. EPA expressed concern that the REI-10-3 well may not be representative because of the low transmissivity associated with the single well recovery analysis of the short term (15- minute) test performed on May 26, 1988. It appeared that the low transmissivity calculated from the short term single well test results could have been due to well inefficiency as suggested by the low pumping rate and large drawdown in this well. Such well inefficiency would also cause well bore storage effects to be significant for unconfined conditions. Well bore effects could also contribute to the lower transmissivity estimate for this short term test.

It was agreed by personnel from Region VI of the U.S. EPA that contractors to the French Limited Task Group, Inc. would perform a step drawdown or variable rate test on wells REI-10-2, REI-10-3 and REI-10-4 in order to select a well for a six- to eight-hour pumping test. The contractors performing the pump tests, Applied Hydrology Associates (AHA) and ERT, proposed to pump each well for 30 minutes at 1.5 gpm, then raise the pumping rate to 2.5 gpm for 30 minutes and then pump for an additional 30 minutes at a higher rate if drawdown had not approached the pumping level. It was agreed that the test would be terminated if drawdown to the pump caused the pumping rate to drop significantly. Recovery measurements would be taken following termination of pumping.

A variable rate test was performed on well REI-10-4 by ERT personnel. Lithologic and well completion logs and an illustration of the location of the pumped well, REI-10-4, and the observation wells, REI-10-2 and REI-10-3, precede the aquifer test data which follow.

Prior to pumping well REI-10-4, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to .01 feet. The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder on the pumped well and on wells REI-10-2 and REI-10-3.

The drawdown values were corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

The attached data sheets present the measurements for the pumped well and the observation wells during the pump test and recovery period. The data sheets include the observed drawdowns and the corrected drawdowns.

Well REI-10-4 was pumped at 1.5 gpm for 30 minutes. The well was allowed to recover for 75 minutes and was then pumped at 2.5 gpm until the pump broke suction after 26 minutes. Recovery measurements were not taken.

Flow rates were measured with an in-line Rotometer but were not checked with bucket and stop watch measurements. Water from the test was pumped directly into the French Limited Lagoon.

INTERPRETATION:

The observation wells REI-10-3 and REI-10-2 showed a very slight response due to pumping well REI-10-4. The water levels in both wells dropped during the latter portion of the pumping period but the drawdown response was too slight to allow for a satisfactory match with a Theis curve or a Boulton Delayed Yield curve. Furthermore, the variable pumping rate would have rendered any match curve estimates of questionable validity.

The u value at the radius of the observation wells was too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers (1980) for variable pumping rates. The technique is appropriate for analyses of aquifer tests in which the dimensionless parameter $u = r^2S/4Tt$ is less than 0.01:

where $r$ is the radial distance between the pumped well and the observation well (feet),
$S$ is the storage coefficient (dimensionless),
$T$ is the transmissivity (feet$^2$/day), and
$t$ is the time since pumping started (days).

The parameter "u" is less than 0.01 when the radial distance to the observation well is small or when the time of pumping is long. The "u" value at the end of pumping at the nearest observation well REI-10-2, located 53.77 ft from the pumped well, was 0.385 using the transmissivity and storage coefficients from the Boulton Delayed Yield analysis in Figure A2-1. The semi-log technique would be applicable to the pumped well, but the pumped well drawdown response was found to be highly influenced by well bore storage.

Well bore storage effects were significant for the entire pumping period. The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2.1 and shown below:

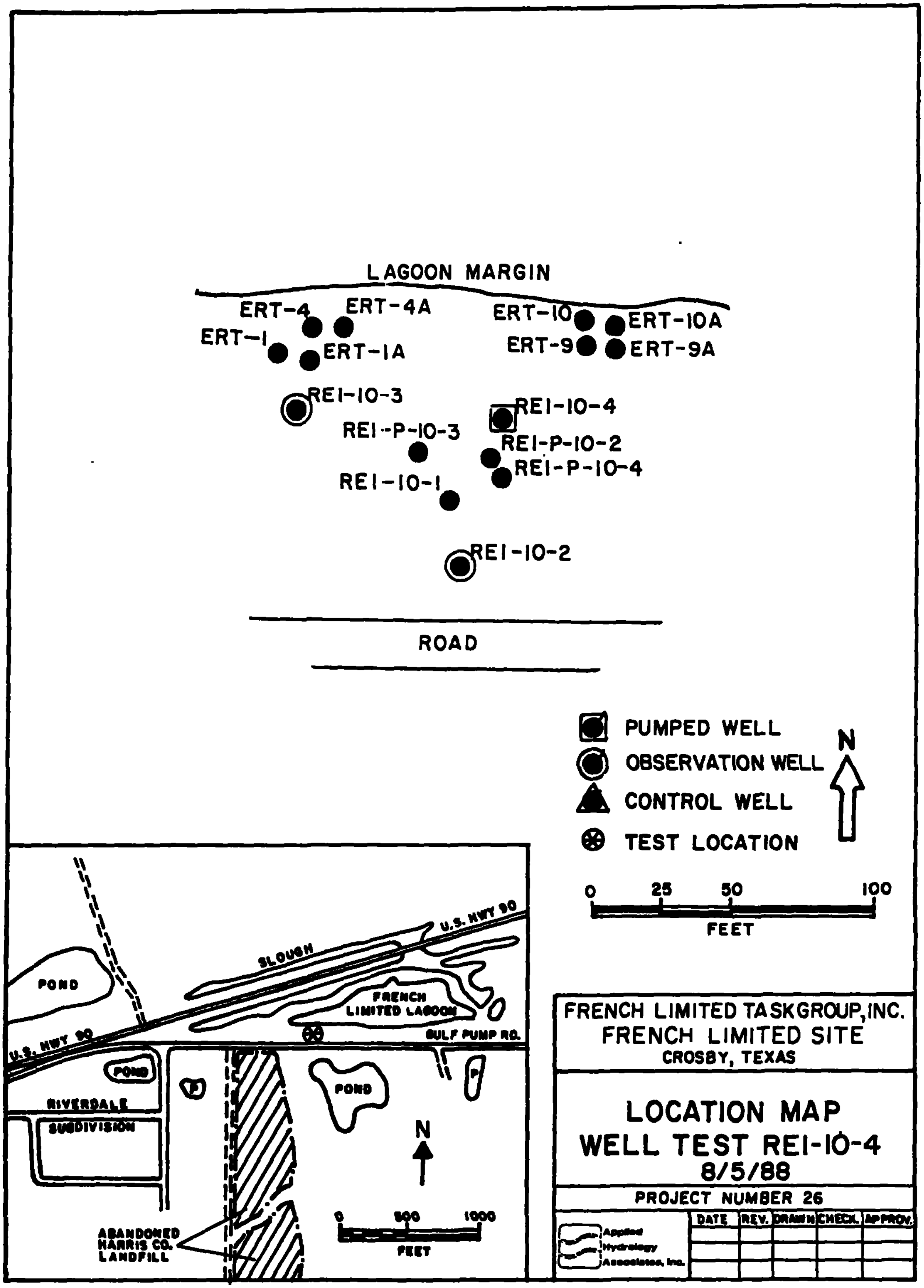
tc > 0.6(16-1)/(1.5/18.62*) = 118 minutes

* drawdown at the end of the 30 minute constant pumping period rather than at time tc.

Drawdown data for the pumped well are included in the attached data sheet. Recovery measurements were not taken. Well bore effects had a significant influence on the entire portion of the response data. Thus the semi-log analysis technique could not be used to provide an estimate of the transmissivity from the drawdown data from the pumped well.

The data from this test could not be used to provide a satisfactory interpretation of aquifer characteristics because of the variable pumping rate, the short duration of test and the lack of recovery measurements. The aquifer characteristics determined from the response in observation well REI-10-4 during the pump test of well ERT-10 provide the best information in the vicinity of the well REI-10-4. These estimates, transmissivity of 145 gpd/ft, hydraulic conductivity of $2.3 \times 10^{-4}$ cm/sec and storage coefficient of 0.00079 are remarkably close to the estimates obtained from the response in well REI-10-4 during the step test of well REI-10-2.

023829




FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS

LOCATION MAP
WELL TEST REI-10-4
8/5/88

PROJECT NUMBER 26

| DATE | REV. | DRAWN | CHECK. | APPROV. |
|---|---|---|---|---|
| | | | | |

023830

**RESOURCE ENGINEERING**

**SUBSURFACE EXPLORATION**



# LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-4

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-4
Logged By: S. L. Baird
Approved By:
Drilled By: S&L

**DRILLING AND SAMPLING INFORMATION**

Date Started: 7/28/86 Date Completed: 7/28/86
Method: MR Total Depth: 48.0 FEET

**WELL COMPLETION INFORMATION**

Screen Dia.: 4" Length: 12.80'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 36.99

SURFACE ELEVATION 14.40

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE FILL, rubber | 8.4 | | | | | | |
| | SAND AND GRAVEL | 5.9 | | | | | | |
| 10 | CLAYEY SAND | 1.9 | | | | | | |
| 20 | SILTY SAND | -14.1 | | | | | | |
| 30 | SANDY SILT | -17.1 | | | | | | |
| | CLAYEY SILT | -20.6 | | | | | | |
| | SLIGHTLY SILTY CLAY | -22.6 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.6 | | | | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48.0'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023831

# RESOURCE ENGINEERING
SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-2

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-2
Logged By: S. L. Baird
Approved By:
Drilled By: GCC

**DRILLING AND SAMPLING INFORMATION**
Date Started: 8/8/86 Date Completed: 8/8/86
Method: MR Total Depth: 48.0 FEET

**WELL COMPLETION INFORMATION**
Screen Dia.: 4" Length: 13.75'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 36.61

SURFACE ELEVATION 11.90

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SAND AND GRAVEL | 2.9 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | .9 | | | | | | |
| | SILTY SAND | -16.1 | | | | | | |
| 30 | SILTY CLAY | -20.1 | | | | | | |
| | SILTY SAND, gray green, strong odor, wet | | 1 | SS | 67 | | | |
| | | | 2 | SS | [illegible] | | | |
| 40 | | -30.1 | 3 | SS | 80 | | | |
| | SLIGHTLY CLAYEY SAND, gray with yellowish brown stain, some lignite chips | | 4 | SS | [illegible] | | | |
| | | | 5 | SS | 27 | | | |
| | SILTY CLAY | -35.1 | 6 | SS | 67 | | | |
| | | [illegible] | 7 | SS | 100 | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 36'. CONTINUOUSLY SAMPLED IN 3-7/8" BORING TO 49.5. UPPER HOLE COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. ELECTRIC LOGGED. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023832

# RESOURCE ENGINEERING

SUBSURFACE EXPLORATION



## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-3

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-3
Logged By: S. L. Baird
Approved By:
Drilled By: SWL

DRILLING AND SAMPLING INFORMATION
Date Started: 7/27/86 Date Completed: 7/27/86
Method: MR Total Depth: 48.0 FEET

WELL COMPLETION INFORMATION
Screen Dia.: 4" Length: 10.30'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 39.66

SURFACE ELEVATION 13.80

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE FILL AND GRAVEL | 10.7 | | | | | | |
| | SAND AND GRAVEL | 4.3 | | | | | | |
| 10 | SLIGHTLY CLAYEY SAND | 2.6 | | | | | | |
| | SILTY SAND | -18.6 | | | | | | |
| 30 | SANDY SILT/CLAYEY SILT | -24.2 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.7 | | | | | | |
| | VERY SILTY CLAY, reddish brown | -34.2 | 1 | SS | 53 | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING, AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURREY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

Depth scale: 0, 10, 20, 30, 40, 50

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

STEP DRAWDOWN TEST - WELL REI-10-4

Saturated Thicknes 48 feet

static water level 5.68 feet

| TIME-t | DEPTH | DRAWDOWN | ADJUSTED DRAWDOWN | RECOVERY TIME-t' | t/t' |
|---|---|---|---|---|---|
| min | ft | ft | ft | min | |
| 0 | 5.68 | 0 | 0 | | |
| 0.5 | 6.1 | | | | |
| 1 | 6.65 | | | | |
| 1.5 | 7.2 | | | | |
| 2 | 7.8 | | | | |
| 2.5 | 7.9 | | | | |
| 3 | 7.95 | | | | |
| 3.5 | 8 | | | | |
| 4 | 9.15 | | | | |
| 4.5 | 10 | | | | |
| 5 | 11.14 | | | | |
| 6 | 12.65 | | | | |
| 7 | 13.75 | | | | |
| 8 | 14.6 | | | | |
| 9 | 15.2 | | | | |
| 10 | 16 | | | | |
| 12 | 17.7 | | | | |
| 14 | 19.05 | | | | |
| 16 | 20.15 | | | | |
| 18 | 21.1 | | | | |
| 20 | 21.82 | | | | |
| 22 | 22.48 | | | | |
| 24 | 23 | | | | |
| 26 | 23.45 | | | | |
| 28 | 23.8 | | | | |
| 30 | 24.3 | | | | |
| 106 | 11.9 | | | | |
| 106.5 | 13.02 | | | 40.5 | |
| 107 | 14.65 | | | 41 | 2.609756 |
| 107.5 | 15.2 | | | 41.5 | 2.590361 |
| 108 | 16.15 | | | 42 | 2.571428 |
| 108.5 | 17 | | | 42.5 | 2.552941 |
| 109 | 18.15 | | | 43 | 2.534883 |
| 109.5 | 19.12 | | | 43.5 | 2.517241 |
| 110 | 20.05 | | | 44 | 2.5 |
| 111 | 22.15 | | | 45 | 2.466666 |
| 112 | 24.27 | | | 46 | 2.434782 |
| 113 | 26.05 | | | 47 | 2.404255 |
| 114 | 27.2 | | | 48 | 2.375 |

023834

| | | | |
|---|---|---|---|
| 115 | 28.55 | 49 | 2.346938 |
| 117 | 30.52 | 51 | 2.294117 |
| 119 | 32.15 | 53 | 2.245283 |
| 121 | 33.7 | 55 | 2.2 |
| 123 | 34.72 | 57 | 2.157894 |
| 125 | 35.7 | 59 | 2.118644 |
| 127 | 35.15 | 61 | 2.081967 |
| 129 | 36.4 | 63 | 2.047619 |
| 131 | broke suction | 65 | 2.015384 |

STEP DRAWDOWN TEST - WELL REI-10-4

OBSERVATION WELL REI-10-2

Saturated Thicknes 48 feet

static water level 5.83 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft |
|---|---|---|---|
| 0 | 5.83 | 0.00 | 0.00 |
| 0.5 | 5.78 | -0.05 | -0.05 |
| 1.5 | 5.78 | -0.05 | -0.05 |
| 2.5 | 5.78 | -0.05 | -0.05 |
| 3.5 | 5.78 | -0.05 | -0.05 |
| 4.5 | 5.78 | -0.05 | -0.05 |
| 6 | 5.78 | -0.05 | -0.05 |
| 8 | 5.78 | -0.05 | -0.05 |
| 10 | 5.8 | -0.03 | -0.03 |
| 12 | 5.8 | -0.03 | -0.03 |
| 14 | 5.8 | -0.03 | -0.03 |
| 17 | 5.8 | -0.03 | -0.03 |
| 22 | 5.8 | -0.03 | -0.03 |
| 26 | 5.82 | -0.01 | -0.01 |
| 30 | 5.85 | 0.02 | 0.02 |
| 107.5 | 5.85 | 0.02 | 0.02 |
| 109.5 | 5.85 | 0.02 | 0.02 |
| 113 | 5.85 | 0.02 | 0.02 |
| 115 | 5.85 | 0.02 | 0.02 |
| 117 | 5.85 | 0.02 | 0.02 |
| 119 | 5.85 | 0.02 | 0.02 |
| 121 | 5.86 | 0.03 | 0.03 |
| 127 | 5.86 | 0.03 | 0.03 |
| 131 | 5.92 | 0.09 | 0.09 |

023836

STEP DRAWDOWN TEST - WELL REI-10-4

OBSERVATION WELL REI-10-3

Saturated Thicknes 48 feet

static water level 5.41 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft |
|---|---|---|---|
| 0 | 5.41 | 0.00 | 0.00 |
| 1 | 5.37 | -0.04 | -0.04 |
| 2 | 5.4 | -0.01 | -0.01 |
| 3 | 5.4 | -0.01 | -0.01 |
| 4 | 5.4 | -0.01 | -0.01 |
| 5 | 5.4 | -0.01 | -0.01 |
| 7 | 5.4 | -0.01 | -0.01 |
| 9 | 5.4 | -0.01 | -0.01 |
| 11 | 5.4 | -0.01 | -0.01 |
| 13 | 5.4 | -0.01 | -0.01 |
| 15 | 5.4 | -0.01 | -0.01 |
| 19 | 5.4 | -0.01 | -0.01 |
| 24 | 5.4 | -0.01 | -0.01 |
| 28 | 5.4 | -0.01 | -0.01 |
| 32 | 5.4 | -0.01 | -0.01 |
| 107 | 5.4 | -0.01 | -0.01 |
| 109 | 5.4 | -0.01 | -0.01 |
| 112 | 5.4 | -0.01 | -0.01 |
| 114 | 5.4 | -0.01 | -0.01 |
| 116 | 5.4 | -0.01 | -0.01 |
| 118 | 5.4 | -0.01 | -0.01 |
| 120 | 5.4 | -0.01 | -0.01 |
| 124 | 5.4 | -0.01 | -0.01 |
| 129 | 5.4 | -0.01 | -0.01 |
| 131 broke suction | | | |

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 9, 1988

PUMPED WELL: ERT-7

OBSERVATION WELLS: ERT-7A, radial distance 11.2feet
ERT-8, radial distance 9.2 feet and
ERT-8A, radial distance 14.3 feet

CONTROL WELLS: REI-10-4, ERT-1 and REI-6-2

BACKGROUND AND DESCRIPTION OF TEST:

Well ERT-7 was identified in the water sampling program as one of the most productive wells about the French Limited site. However, the preliminary aquifer test program described in Attachment 1 above did not show the transmissivity at this well to be higher than other wells thought to be less productive. Since the preliminary testing program results were based on short pumping periods with possible error in the flow estimates, it was decided to perform a longer term controlled test on well ERT-7. Additionally, the test was conducted to provide information about aquifer characteristics in the vicinity of possible groundwater recovery wells south of the French Limited Lagoon. With the nearby observation wells ERT-8, ERT-8A and ERT-7A, personnel performing the aquifer test were assured of obtaining response information which could be used to derive estimates of storage coefficients and vertical hydraulic conductivities as well as provide estimates of transmissivity.

During the preliminary shallow aquifer test, well ERT-7 was pumped at 12.6 gpm for 9.6 minutes. Maximum drawdown was about 12.4 feet. Based on these results and discussions with individuals involved in sampling the wells, it was decided to pump well ERT-7 at about six gpm for the anticipated eight-hour test.

Lithologic and well completion logs and an illustration of the location of the pumped well, ERT-7, and the observation wells precede the aquifer test data which follow.

Prior to pumping the well, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to .01 feet. The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder at the pumped well, at the observation wells and at the control wells.

Drawdown values determined from water level measurements in wells ERT-7 and ERT-8 were adjusted using Jacob's (1963) correction to allow the solutions for confined aquifers to better apply to unconfined conditions:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

The attached data sheets present the measurements for the pumped well, the observation wells and the control wells during the pump test and recovery period.

The test was started and the flow rate as measured by a Rotometer was set at the maximum rate of six gpm. Subsequent measurements with a five-gallon bucket and stop watch showed this pumping rate to hold constant at 6.67 gpm throughout the entire test. Total pumping time was 8.25 hours.

The control wells were monitored approximately hourly during the pumping period. Water level measurements were taken periodically at the pumping well and the observation wells during the first four hours following termination of pumping. An additional water level measurement was taken about 10.5 hours following termination of pumping.

Water produced from the test was pumped directly into the French Limited Lagoon.

INTERPRETATION:

The control wells ERT-1, REI-10-4, and REI-6-2 showed no obvious trends during pumping. The water levels in all three wells fluctuated within about 0.1 feet (see attached data sheets and plots). In all three wells the highest water levels were observed at about 17:40 (5:40 p.m.). In the control wells REI-10-4 and ERT-1, the lowest water levels were observed near the end of the test. However, the total water level drop in these two wells was only 0.07 and 0.05 feet respectively. Based on the pattern of fluctuations seen in the control wells, it was thought that there was no basis to adjust observation well measurements for extraneous influences. Also, it was concluded that there was no obvious response in the control wells due to pumping ERT-7 for 8.25 hours.

By use of the transmissivity and storage coefficients from the Theis Recovery analysis (Figure A2-4), the dimensionless parameter $u = r^2S/4Tt$ at the radius of the observation well, ERT-8 was less than 0.01 after 68 minutes of pumping.

Based on the "u" parameter criterion, the semi-log techniques would be applicable to nearly the entire data range for the pumped well except that portion subject to well bore storage influences. The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2.1 and shown below:

$$tc = 0.6(16-1)/(6.67/5.27^*) = 7.11 \text{ minutes}$$

* drawdown at time tc = 7 min.

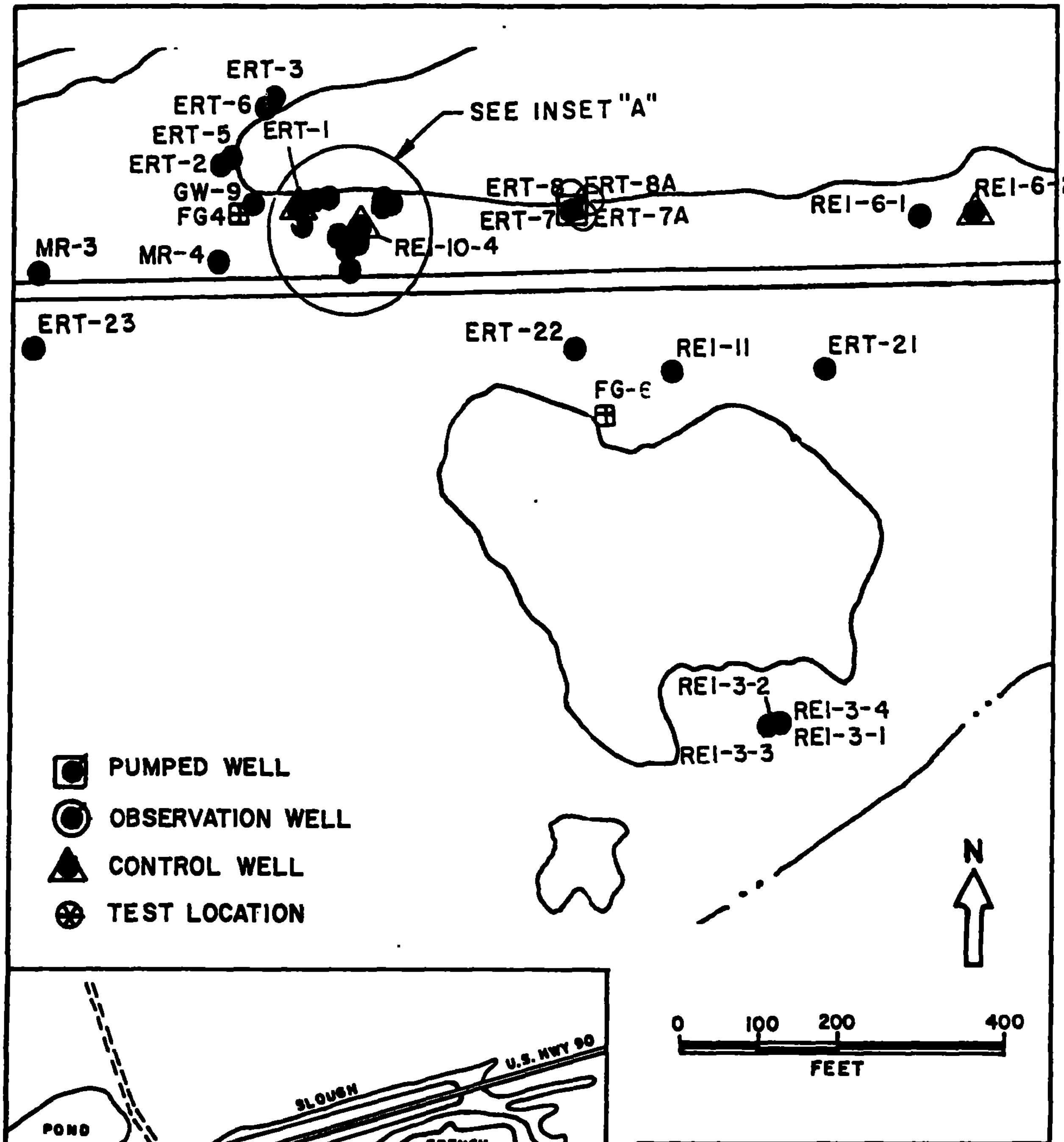
Adjusted drawdown for wells ERT-7 and ERT-8 were plotted against the log of time on the attached Cooper and Jacob (1946) semi-log plots as provided in Figures A2-2 and A2-3. Delayed yield effects that are often typical of water table pump test response (see Neuman, 1975) were not obvious in either plot but could be associated with the slight flattening of the semi-log response curve between 20 and 80 minutes into the test. It is also possible that the more rapid decline near the end of the test was due to the influence of the lower permeability zones known to exist to the east, west and south of well ERT-7. These lower permeable zones would exhibit such an impermeable-boundary effect. Aquifer characteristics were calculated using the results of the drawdown analysis. However, it was concluded that the analysis of the recovery data would provide more accurate results because of the longer duration of the recovery measurement period and the fact that the recovery data would be less sensitive to fluctuations in pumping rates.

The water level recovery data from wells ERT-7 and ERT-8 were analyzed on semi-log Theis (1935) recovery plots of residual drawdown values adjusted using Jacob's correction versus the log of t/t', where t is time since pumping started and t' is time since pumping stopped. The residual drawdown plots in Figures A-4 and A-5 did not exhibit the fluctuations apparent in the drawdown analyses. It is quite possible that the influence of the lower permeability of the aquifer beyond the zone around the pumping well has resulted in a slight decline in the recovery observed in the last measurements. Nevertheless, there was no apparent influence of the lagoon boundary in the recovery measurements.

Transmissivity values computed from the residual drawdown (recovery) analyses were 1387 gpd/ft. and 1854 gpd/ft for wells ERT-8 and ERT-7, respectively. The storage coefficient determined from the residual drawdown analysis from observation well ERT-8 was 0.0041. This storage coefficient is comparable to the upper range observed in confined aquifers. This storage coefficient represents the early test or type A results from Neuman (1975) and does not represent the specific yield of the unconfined aquifer.

Results from observation wells ERT-7A and ERT-8A cannot be interpreted by conventional techniques nor provide meaningful results. The delay in the response of these wells is indicative of values of vertical hydraulic conductivity that are much lower than the horizontal hydraulic conductivity. Nevertheless, the vertical hydraulic conductivity in the vicinity of wells ERT-7A and ERT-8A are high in comparison with the vertical hydraulic conductivities indicated by the lack of response in the shallow wells during pump testing of well ERT-10.

023840




FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS

LOCATION MAP
WELL TEST ERT-7
8/9/88

PROJECT NUMBER 26

| Applied Hydrology Associates, Inc. | DATE | REV. | DRAWN | CHECK. | APPROV. |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

023841

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## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-7

Client : French LTD.
Project Name : French LTD.
Project Location : Crosby, Texas
Job Number : 275-21 Boring No : ERT-7
Logged By : D. Morgan
Approved By : G. Spradley
Drilled By : Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started : 9/28/87 Date Completed : 9/28/87
Method : MR Total Depth : 48'

WELL COMPLETION INFORMATION
Screen Dia : 4" Length : 28.0'
Slot Size : .010 Type : PVC
Casing Dia : 4" Length : 17.7'

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION : ) | SAMPLE NO. | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT |
|---|---|---|---|---|---|---|
| | Fill, roadbase, gravel, sand, silt | 1 | ST | 80 | - | |
| 5 | Silty Sand, tan to brown/ gray, fine to medium grained some black sludge material | 2 | SS | 50 | 0.4 | |
| | | 3 | SS | 50 | 0.2 | |
| 10 | | 4 | SS | 45 | 0.2 | |
| | | 5 | SS | 25 | 0.2 | |
| | | 6 | SS | 50 | 0.6 | |
| 15 | | 7 | SS | 50 | 0.8 | |
| | Sand, fine to medium grained, gray, strong odor | 8 | SS | 13 | 0.4 | |
| 20 | | 9 | SS | NR | | |
| | | 10 | SS | 17 | - | |
| | | 11 | SS | 45 | - | |
| 25 | | 12 | SS | 25 | - | |
| | | 13 | SS | 25 | - | |
| 30 | Silty Clay, gray with some red/brown mottles, stiff, with some fine grained sand seams some odor | 14 | SS | 50 | - | |
| | | 15 | ST | 75 | - | |
| | | 16 | ST | 50 | - | |
| 35 | Clayey Silt, light gray, soft, saturated some odor | 17 | ST | 75 | - | |
| | | 19 | ST | NR | | |
| 40 | | 20 | ST | 75 | - | |
| | | 21 | SS | 50 | - | |
| | | 22 | SS | 65 | - | |
| 45 | | 23 | ST | 50 | - | |
| | Silty Clay, light gray, stiff, some tan mottles, no odor | 24 | ST | 84 | - | |
| 50 | BORING TERMINATED AT 48.0' | | | | | |
| 55 | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

02 3842

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Sheet 1 of 1

## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-8

Client : French LTD.
Project Name : French LTD.
Project Location : Crosby, Texas
Job Number : 275-21 Boring No : ert-8
Logged By : D. Morgan
Approved By : G. Spradley
Drilled By : Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started : 9/28/87 Date Completed : 9/28/87
Method : MR Total Depth : 50'

WELL COMPLETION INFORMATION
Screen Dia : 4" Length : 29.5'
Slot Size : .010 Type : PVC
Casing Dia : 4" Length : 19.6'

| DEPTH IN FEET | DESCRIPTION<br>SURFACE ELEVATION : | SAMPLE NO. | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Fill, roadbase, gravel, silt, sand | | | | | | | | | |
| 3 | Silty Sand, gray | | | | | | | | | |
| 20 | Sand, fine to medium grained | | | | | | | | | |
| 28 | Clayey Silt, gray, some odor | | | | | | | | | |
| 48 | Silty Clay, light gray, some tan mottles | 1 | SS | 50 | - | | | | | |
| 50 | Stratigraphic breaks determined by advance of boring, cuttings, and information obtained from adjacent well ERT-7 | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE

BORING METHOD
HSA - HOLLOW STEM AUGER
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

**ERT** 02 3843

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-7A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-7A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

DRILLING AND SAMPLING INFORMATION
Date Started: 11-17-87 Date Completed: 11-17-87
Method: Mud Rotary Total Depth: 20.5 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch Ø Length: 15.0 feet
Slot Size: 0.010 inch Type: PVC
Casing Dia.: 4-inch Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.5') | | | | | | | | | |
| | Gray medium to fine silty sand | | | | | | | | | |
| 25 | (25.0') | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

ERT 023844

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# BORING LOG AND CONSTRUCTION OF ERT-8A

Client ARCO Chemical Company
Project Name French Limited Site
Project Location Crosby, Texas
Job No. 275-23-01 Boring No. ERT-8A
Logged By Steve Preston
Approved By
Drilled By PSI, Inc. Driller's Name R. Spencer

DRILLING AND SAMPLING INFORMATION

Date Started 11-17-87 Date Completed 11-17-87
Method Mud Rotary Total Depth 20.5 feet

WELL COMPLETION INFORMATION

Screen Dia. 4-inch Ø Length 15.0 feet
Slot Size 0.010-inch Type PVC
Casing Dia. 4-inch Ø Length 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.0') | | | | | | | | | |
| | - Gray sandy clay | | | | | | | | | |
| | - Gray fine to medium silty sand | | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | (22.0') | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023845

# RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

Sheet 1 of 1

## LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-4

| | |
|---|---|
| Client | FRENCH LTD. TASK GROUP |
| Project Name | French Ltd. 1986 F.I. |
| Project Location | Crosby, Texas |
| Job No. | 275-14 |
| Boring No. | 10-4 |
| Logged By | S. L. Baird |
| Approved By | |
| Drilled By | SWL |

**DRILLING AND SAMPLING INFORMATION**

| | | | |
|---|---|---|---|
| Date Started | 7/28/86 | Date Completed | 7/28/86 |
| Method | MR | Total Depth | 48.0 FEET |

**WELL COMPLETION INFORMATION**

| | | | |
|---|---|---|---|
| Screen Dia. | 4" | Length | 12.80' |
| Slot Size | 0.010" | Type | PVC |
| Casing Dia. | 4" | Length | 36.99 |

SURFACE ELEVATION 14.40

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE FILL, rubber | 8.4 | | | | | | |
| | SAND AND GRAVEL | 5.9 | | | | | | |
| 10 | CLAYEY SAND | 1.9 | | | | | | |
| 20 | SILTY SAND | -14.1 | | | | | | |
| 30 | SANDY SILT | -17.1 | | | | | | |
| | CLAYEY SILT | -20.6 | | | | | | |
| | SLIGHTLY SILTY CLAY | -22.6 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.6 | | | | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48.0'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

02 846

**ERI**

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Sheet 1 of 1

FIGURE 4-3

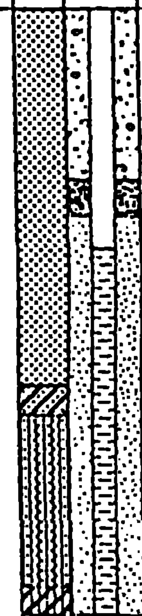
# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 1

Client French Ltd. Task Group
Project Name Bioremediation
Project Location Crosby, TX
Job No 275-21 MW ERT 1
Logged By SLB
Approved By
Drilled By JS

DRILLING AND SAMPLING INFORMATION
Date Started 3/11/87 Date Completed 3/11/87
Method RW Total Depth 50 feet

WELL COMPLETION INFORMATION
Screen Dia. 4" Length 30 feet
Slot Size 0.010" Type PVC
Casing Dia. 4" Length 20 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLED INTERVALS, HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | SURFACE ELEVATION | | | | | | | | |
| 10 | SILTY SAND-gray, medium to fine grain, wet, asorted multicolored fines,odor | | | | | | | | |
| 20 | thin gravel ledge, slight odor, dark gray sludge | | | | | | | | |
| 30 | SANDY CLAY-gray, multicolor gravels washing from above | | | | | | | | |
| | SANDY SILT & SILTY SAND-tan, strong odor | | | | | | | | |
| 40 | | | | | | | | | |
| 50 | VERY SILTY CLAY-gray and white ,odor | | | | | | | | |



FORMATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE,CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CC-CONTINUOUS CORNER
ST - PRESSED SHELBY TUBE CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS AR-AIR ROTARY
CFA - CONTINUOUS FLIGHT AUGERS RW-ROTARY WASH

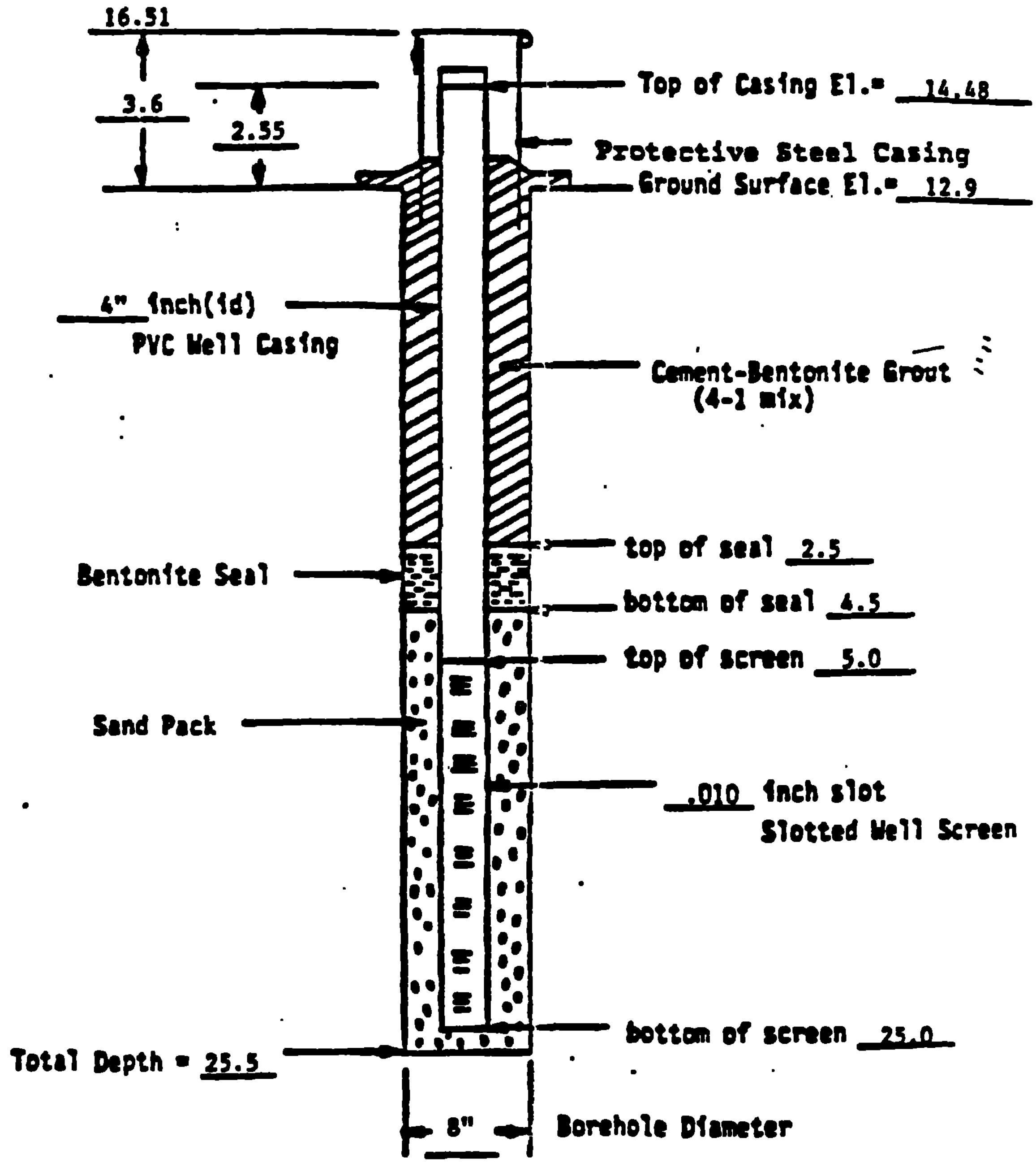
023847

## Details of Monitor Well Construction

**Project Name:** FRENCH LIMITED SITE **Boring Number:** REI:6-2

**Project Number:** 275-02 **Date Installed:** 3-7-84

**Water Level Measurement:** 6.65 (El. = 8.83 on 4-10-84)




REI

023848

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client FRENCH LIMITED TASK FORCE  Boring # REI:6-2
Architect Engineer C.Itin  Job # 275-02
Project Name French Site  Drawn By JB
Project Location Crosby, Texas  Approved By JDA

DRILLING and SAMPLING INFORMATION

Date Started 3-3-84  Hammer Wt. 140 lbs.
Date Completed 3-3-84  Hammer Drop 30 in.
Drill Foreman G.Littel  Spoon Sampler OD 2 in.
Inspector JB  Rock Core Dia. - in.
Boring Method RW  Shelby Tube OD 3 in.

TEST DATA

| SOIL CLASSIFICATION<br>SURFACE ELEVATION – | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qu Tons/Ft.² Pocket Penetrometer qp Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY CLAYEY SAND, fine grained brown to gray, with some thin silty clay seams (SM-SC) | 4.5 | | | | | | | | | | | |
| SAND, fine to medium grained gray, loose (SP-SW) | | 5 | | | | | | | | | | |
| | | 10 | | | | | | | | | | |
| | | 15 | | | | | | | | | | |
| | | 20 | | | | | | | | | | |
| Change to Silty Clay at 25.0' | 25.0 | 25 | | | | | | | | | | |
| Boring Terminated at 25.0' | | | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

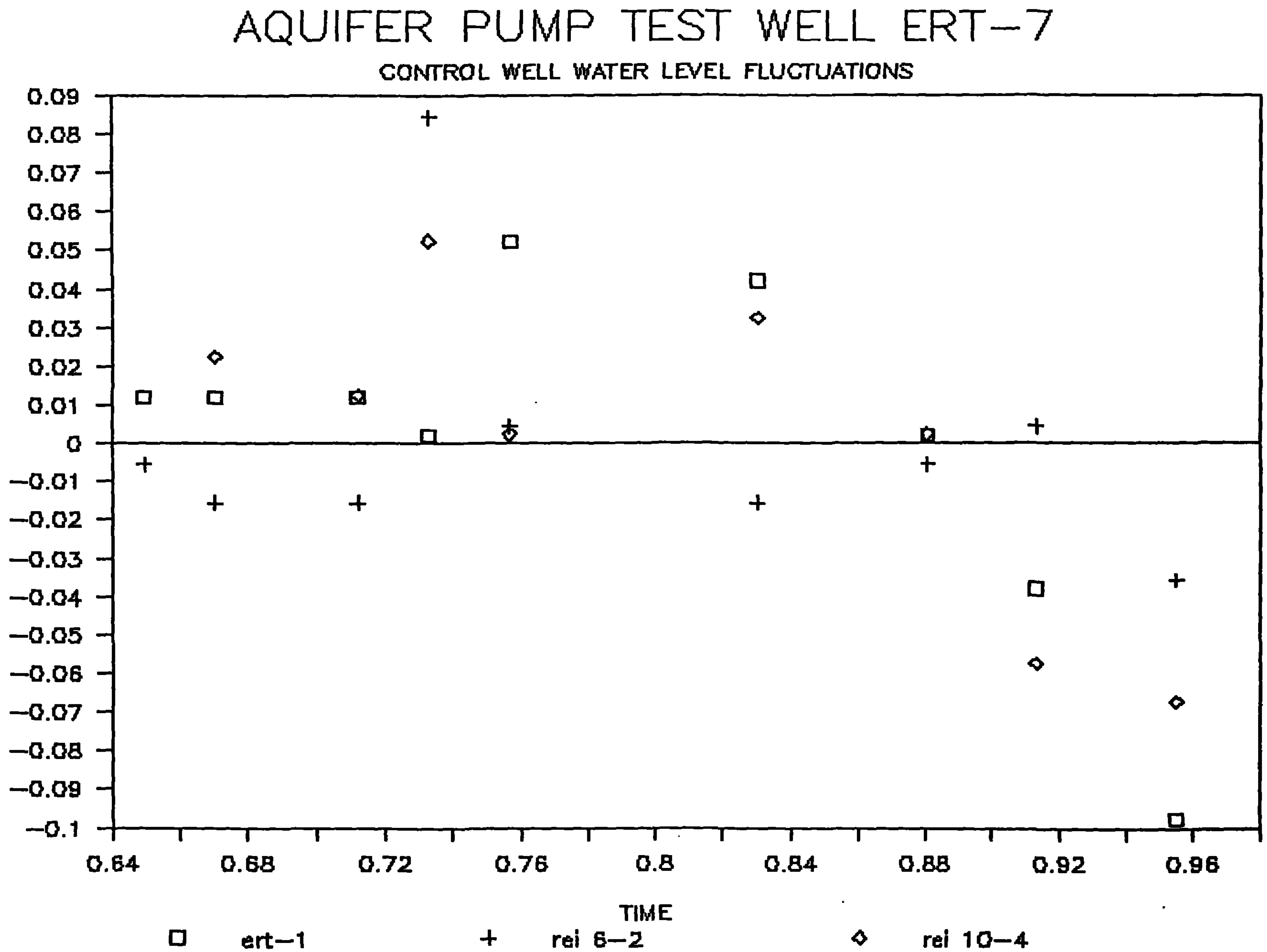
BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

023849

PUMPED WELL: ERT-7 Aug 9, 1988

CONTROL WELL WATER LEVEL FLUCTUATIONS

| HOUR | MIN | ERT 1 | MEAN-DEV ERT 1 6.572 | REI 6-2 | MEAN-DEV REI 6-2 7.1644 | REI 10-4 | MEAN-DEV REI 10-4 5.693 |
|---|---|---|---|---|---|---|---|
| 15 | 35 | 6.56 | 0.01 | | | | |
| 16 | 5 | 6.56 | 0.01 | | | | |
| 17 | 5 | 6.56 | 0.01 | | | | |
| 17 | 35 | 6.57 | 0.00 | | | | |
| 18 | 9 | 6.52 | 0.05 | | | | |
| 19 | 55 | 6.53 | 0.04 | | | | |
| 21 | 8 | 6.57 | 0.00 | | | | |
| 21 | 55 | 6.61 | -0.04 | | | | |
| 22 | 55 | 6.67 | -0.10 | | | | |
| 15 | 45 | | | 7.17 | -0.01 | | |
| 16 | 16 | | | 7.18 | -0.02 | | |
| 16 | 45 | | | 7.18 | -0.02 | | |
| 17 | 45 | | | 7.08 | 0.08 | | |
| 18 | 18 | | | 7.16 | 0.00 | | |
| 19 | 45 | | | 7.18 | -0.02 | | |
| 20 | 50 | | | 7.17 | -0.01 | | |
| 22 | 5 | | | 7.16 | 0.00 | | |
| 23 | 5 | | | 7.20 | -0.04 | | |
| 15 | 45 | | | | | | |
| 16 | 30 | | | | | 5.67 | 0.02 |
| 17 | 0 | | | | | 5.68 | 0.01 |
| 17 | 45 | | | | | 5.64 | 0.05 |
| 18 | 12 | | | | | 5.69 | 0.00 |
| 18 | 50 | | | | | 5.66 | 0.03 |
| 21 | 5 | | | | | 5.69 | 0.00 |
| 21 | 58 | | | | | 5.75 | -0.06 |
| 22 | 58 | | | | | 5.76 | -0.07 |



AQUIFER PUMP TEST WELL ERT-7
CONTROL WELL WATER LEVEL FLUCTUATIONS
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
−0.07
−0.08
−0.09
−0.1
0.64
0.68
0.72
0.76
0.8
0.84
0.88
0.92
0.96
TIME
ert−1
rei 6−2
rei 10−4


B-209

023850

023851

AQUIFER PUMP TEST - WELL ERT-7

Saturated Thickness 48 feet Date: 8/10/88

static water level 4.73 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0.00 | 4.73 | 0.00 | 0.00 | | |
| 1.00 | 8.15 | 3.42 | 3.30 | | |
| 2.00 | 8.82 | 4.09 | 3.92 | | |
| 3.00 | 9.06 | 4.33 | 4.13 | | |
| 4.00 | 9.15 | 4.42 | 4.22 | | |
| 5.00 | 9.66 | 4.93 | 4.68 | | |
| 6.00 | 9.80 | 5.07 | 4.80 | | |
| 7.00 | 10.00 | 5.27 | 4.98 | | |
| 8.00 | 10.07 | 5.34 | 5.04 | | |
| 10.00 | 10.26 | 5.53 | 5.21 | | |
| 12.00 | 10.41 | 5.68 | 5.34 | | |
| 14.00 | 10.66 | 5.93 | 5.56 | | |
| 16.50 | 10.90 | 6.17 | 5.77 | | |
| 18.00 | 10.89 | 6.16 | 5.76 | | |
| 20.00 | 10.97 | 6.24 | 5.83 | | |
| 25.00 | 11.15 | 6.42 | 5.99 | | |
| 30.00 | 11.33 | 6.60 | 6.15 | | |
| 35.00 | 11.41 | 6.68 | 6.22 | | |
| 40.00 | 11.53 | 6.80 | 6.32 | | |
| 45.00 | 11.63 | 6.90 | 6.40 | | |
| 50.00 | 11.71 | 6.98 | 6.47 | | |
| 55.00 | 11.87 | 7.14 | 6.61 | | |
| 65.00 | 12.13 | 7.40 | 6.83 | | |
| 75.00 | 12.31 | 7.58 | 6.98 | | |
| 86.00 | 12.75 | 8.02 | 7.35 | | |
| 95.00 | 12.90 | 8.17 | 7.47 | | |
| 105.50 | 12.90 | 8.17 | 7.47 | | |
| 135.00 | 13.36 | 8.63 | 7.85 | | |
| 165.00 | 13.64 | 8.91 | 8.08 | | |
| 195.00 | 14.07 | 9.34 | 8.43 | | |
| 255.00 | 14.65 | 9.92 | 8.89 | | |
| 315.00 | 15.18 | 10.45 | 9.31 | | |
| 375.00 | 15.65 | 10.92 | 9.68 | | |
| 435.00 | 15.93 | 11.20 | 9.89 | | |
| 495.00 | 16.30 | 11.57 | 10.18 | | |
| 495.50 | 13.42 | 8.69 | 7.90 | 0.50 | 991.00 |
| 496.00 | 10.87 | 6.14 | 5.75 | 1.00 | 496.00 |
| 497.00 | 8.60 | 3.87 | 3.71 | 2.00 | 248.50 |
| 498.00 | 7.55 | 2.82 | 2.74 | 3.00 | 166.00 |
| 499.00 | 7.03 | 2.30 | 2.24 | 4.00 | 124.75 |
| 500.00 | 6.72 | 1.99 | 1.95 | 5.00 | 100.00 |
| 501.00 | 6.61 | 1.88 | 1.84 | 6.00 | 83.50 |
| 502.00 | 6.53 | 1.80 | 1.77 | 7.00 | 71.71 |
| 503.00 | 6.46 | 1.73 | 1.70 | 8.00 | 62.88 |
| 504.00 | 6.39 | 1.66 | 1.63 | 9.00 | 56.00 |

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 505.00 | 6.33 | 1.60 | 1.57 | 10.00 | 50.50 |
| 507.00 | 6.23 | 1.50 | 1.48 | 12.00 | 42.25 |
| 509.00 | 6.17 | 1.44 | 1.42 | 14.00 | 36.36 |
| 511.00 | 6.11 | 1.38 | 1.36 | 16.00 | 31.94 |
| 513.00 | 6.06 | 1.33 | 1.31 | 18.00 | 28.50 |
| 515.00 | 6.02 | 1.29 | 1.27 | 20.00 | 25.75 |
| 520.00 | 5.92 | 1.19 | 1.18 | 25.00 | 20.80 |
| 525.00 | 5.85 | 1.12 | 1.11 | 30.00 | 17.50 |
| 530.00 | 5.80 | 1.07 | 1.06 | 35.00 | 15.14 |
| 535.00 | 5.75 | 1.02 | 1.01 | 40.00 | 13.38 |
| 541.00 | 5.70 | 0.97 | 0.96 | 46.00 | 11.76 |
| 545.00 | 5.68 | 0.95 | 0.94 | 50.00 | 10.90 |
| 555.00 | 5.62 | 0.89 | 0.88 | 60.00 | 9.25 |
| 565.00 | 5.58 | 0.85 | 0.84 | 70.00 | 8.07 |
| 575.00 | 5.55 | 0.82 | 0.81 | 80.00 | 7.19 |
| 585.00 | 5.51 | 0.78 | 0.77 | 90.00 | 6.50 |
| 615.00 | 5.37 | 0.64 | 0.64 | 120.00 | 5.13 |
| 645.00 | 5.30 | 0.57 | 0.57 | 150.00 | 4.30 |
| 675.00 | 5.25 | 0.52 | 0.52 | 180.00 | 3.75 |
| 735.00 | 5.19 | 0.46 | 0.46 | 240.00 | 3.06 |
| 1119.00 | 5.01 | 0.28 | 0.28 | 624.00 | 1.79 |

AQUIFER PUMP TEST - WELL ERT-7

OBSERVATION WELL - ERT-8

Saturated Thickness 45.12 feet Date: 8/9/88

static water level 4.88 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0.00 | 4.88 | 0.00 | 0.00 | | |
| 0.50 | 4.90 | 0.02 | 0.02 | | |
| 1.00 | 4.95 | 0.07 | 0.07 | | |
| 2.00 | 5.06 | 0.18 | 0.18 | | |
| 3.00 | 5.16 | 0.28 | 0.28 | | |
| 4.00 | 5.25 | 0.37 | 0.37 | | |
| 5.00 | 5.35 | 0.47 | 0.47 | | |
| 6.00 | 5.42 | 0.54 | 0.54 | | |
| 7.00 | 5.50 | 0.62 | 0.62 | | |
| 8.00 | 5.56 | 0.68 | 0.67 | | |
| 10.00 | 5.68 | 0.80 | 0.79 | | |
| 12.00 | 5.76 | 0.88 | 0.87 | | |
| 14.00 | 5.84 | 0.96 | 0.95 | | |
| 16.00 | 5.92 | 1.04 | 1.03 | | |
| 18.00 | 5.98 | 1.10 | 1.09 | | |
| 20.00 | 6.03 | 1.15 | 1.14 | | |
| 25.00 | 6.14 | 1.26 | 1.24 | | |
| 30.00 | 6.22 | 1.34 | 1.32 | | |
| 35.00 | 6.29 | 1.41 | 1.39 | | |
| 40.00 | 6.35 | 1.47 | 1.45 | | |
| 45.00 | 6.41 | 1.53 | 1.50 | | |
| 50.00 | 6.45 | 1.57 | 1.54 | | |
| 55.00 | 6.50 | 1.62 | 1.59 | | |
| 65.00 | 6.59 | 1.71 | 1.68 | | |
| 75.00 | 6.68 | 1.80 | 1.76 | | |
| 86.00 | 6.79 | 1.91 | 1.87 | | |
| 95.00 | 6.85 | 1.97 | 1.93 | | |
| 105.00 | 6.91 | 2.03 | 1.98 | | |
| 135.00 | 7.06 | 2.18 | 2.13 | | |
| 165.00 | 7.16 | 2.28 | 2.22 | | |
| 195.00 | 7.31 | 2.43 | 2.36 | | |
| 255.00 | 7.51 | 2.63 | 2.55 | | |
| 315.00 | 7.69 | 2.81 | 2.72 | | |
| 375.00 | 7.85 | 2.97 | 2.87 | | |
| 435.00 | 7.93 | 3.05 | 2.95 | | |
| 494.00 | 8.00 | 3.12 | 3.01 | | |
| 497.00 | 7.90 | 3.02 | 2.92 | 2.00 | 248.50 |
| 498.00 | 7.79 | 2.91 | 2.82 | 3.00 | 166.00 |
| 499.00 | 7.62 | 2.74 | 2.66 | 4.00 | 124.75 |
| 500.00 | 7.48 | 2.60 | 2.53 | 5.00 | 100.00 |
| 501.00 | 7.35 | 2.47 | 2.40 | 6.00 | 83.50 |
| 502.00 | 7.25 | 2.37 | 2.31 | 7.00 | 71.71 |
| 503.00 | 7.16 | 2.28 | 2.22 | 8.00 | 62.88 |

000954

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 504.00 | 7.08 | 2.20 | 2.15 | 9.00 | 56.00 |
| 505.00 | 7.02 | 2.14 | 2.09 | 10.00 | 50.50 |
| 507.00 | 6.91 | 2.03 | 1.98 | 12.00 | 42.25 |
| 509.00 | 6.81 | 1.93 | 1.89 | 14.00 | 36.36 |
| 511.00 | 6.73 | 1.85 | 1.81 | 16.00 | 31.94 |
| 513.00 | 6.66 | 1.78 | 1.74 | 18.00 | 28.50 |
| 515.00 | 6.60 | 1.72 | 1.69 | 20.00 | 25.75 |
| 520.00 | 6.48 | 1.60 | 1.57 | 25.00 | 20.80 |
| 525.00 | 6.38 | 1.50 | 1.48 | 30.00 | 17.50 |
| 530.00 | 6.30 | 1.42 | 1.40 | 35.00 | 15.14 |
| 535.00 | 6.22 | 1.34 | 1.32 | 40.00 | 13.38 |
| 541.00 | 6.16 | 1.28 | 1.26 | 46.00 | 11.76 |
| 545.00 | 6.11 | 1.23 | 1.21 | 50.00 | 10.90 |
| 555.00 | 6.02 | 1.14 | 1.13 | 60.00 | 9.25 |
| 565.00 | 5.95 | 1.07 | 1.06 | 70.00 | 8.07 |
| 575.00 | 5.90 | 1.02 | 1.01 | 80.00 | 7.19 |
| 585.00 | 5.82 | 0.94 | 0.93 | 90.00 | 6.50 |
| 615.00 | 5.69 | 0.81 | 0.80 | 120.00 | 5.13 |
| 645.00 | 5.60 | 0.72 | 0.71 | 150.00 | 4.30 |
| 675.00 | 5.51 | 0.63 | 0.63 | 180.00 | 3.75 |
| 735.00 | 5.40 | 0.52 | 0.52 | 240.00 | 3.06 |
| 1120.00 | 5.15 | 0.27 | 0.27 | 625.00 | 1.79 |

023855

AQUIFER PUMP TEST - WELL ERT-7

OBSERVATION WELL ERT-7A

Saturated Thickness 44.62 feet Date: 8/9/88

static water level 5.38 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0.00 | 5.38 | 0.00 | 0.00 | | |
| 0.50 | 5.38 | 0.00 | 0.00 | | |
| 1.00 | 5.38 | 0.00 | 0.00 | | |
| 2.00 | 5.42 | 0.04 | 0.04 | | |
| 3.00 | 5.46 | 0.08 | 0.08 | | |
| 4.00 | 5.50 | 0.12 | 0.12 | | |
| 5.00 | 5.53 | 0.15 | 0.15 | | |
| 6.00 | 5.55 | 0.17 | 0.17 | | |
| 7.00 | 5.58 | 0.20 | 0.20 | | |
| 8.00 | 5.60 | 0.22 | 0.22 | | |
| 10.00 | 5.65 | 0.27 | 0.27 | | |
| 12.00 | 5.68 | 0.30 | 0.30 | | |
| 14.00 | 5.70 | 0.32 | 0.32 | | |
| 16.00 | 5.74 | 0.36 | 0.36 | | |
| 18.00 | 5.76 | 0.38 | 0.38 | | |
| 20.00 | 5.78 | 0.40 | 0.40 | | |
| 25.00 | 5.84 | 0.46 | 0.46 | | |
| 30.00 | 5.85 | 0.47 | 0.47 | | |
| 35.00 | 5.88 | 0.50 | 0.50 | | |
| 40.00 | 5.90 | 0.52 | 0.52 | | |
| 45.00 | 5.92 | 0.54 | 0.54 | | |
| 50.00 | 5.94 | 0.56 | 0.56 | | |
| 55.00 | 5.96 | 0.58 | 0.58 | | |
| 65.00 | 6.00 | 0.62 | 0.62 | | |
| 75.00 | 6.03 | 0.65 | 0.65 | | |
| 87.00 | 6.10 | 0.72 | 0.71 | | |
| 96.00 | 6.14 | 0.76 | 0.75 | | |
| 106.50 | 6.15 | 0.77 | 0.76 | | |
| 135.00 | 6.22 | 0.84 | 0.83 | | |
| 165.00 | 6.26 | 0.88 | 0.87 | | |
| 195.00 | 6.29 | 0.91 | 0.90 | | |
| 255.00 | 6.38 | 1.00 | 0.99 | | |
| 315.00 | 6.46 | 1.08 | 1.07 | | |
| 375.00 | 6.53 | 1.15 | 1.14 | | |
| 435.00 | 6.57 | 1.19 | 1.17 | | |
| 494.00 | 6.61 | 1.23 | 1.21 | | |
| 494.00 | 6.61 | 1.23 | 1.21 | | |
| 495.50 | 6.60 | 1.22 | 1.20 | 0.50 | 991.00 |
| 496.00 | 6.59 | 1.21 | 1.19 | 1.00 | 496.00 |
| 497.00 | 6.56 | 1.18 | 1.16 | 2.00 | 248.50 |
| 498.00 | 6.50 | 1.12 | 1.11 | 3.00 | 166.00 |
| 499.00 | 6.47 | 1.09 | 1.08 | 4.00 | 124.75 |
| 500.00 | 6.42 | 1.04 | 1.03 | 5.00 | 100.00 |

023856

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 501.00 | 6.40 | 1.02 | 1.01 | 6.00 | 83.50 |
| 502.00 | 6.37 | 0.99 | 0.98 | 7.00 | 71.71 |
| 503.00 | 6.33 | 0.95 | 0.94 | 8.00 | 62.88 |
| 504.00 | 6.32 | 0.94 | 0.93 | 9.00 | 56.00 |
| 505.00 | 6.30 | 0.92 | 0.91 | 10.00 | 50.50 |
| 507.00 | 6.26 | 0.88 | 0.87 | 12.00 | 42.25 |
| 509.00 | 6.24 | 0.86 | 0.85 | 14.00 | 36.36 |
| 511.00 | 6.22 | 0.84 | 0.83 | 16.00 | 31.94 |
| 513.00 | 6.20 | 0.82 | 0.81 | 18.00 | 28.50 |
| 515.00 | 6.18 | 0.80 | 0.79 | 20.00 | 25.75 |
| 520.00 | 6.13 | 0.75 | 0.74 | 25.00 | 20.80 |
| 525.00 | 6.11 | 0.73 | 0.72 | 30.00 | 17.50 |
| 530.00 | 6.07 | 0.69 | 0.68 | 35.00 | 15.14 |
| 535.00 | 6.06 | 0.68 | 0.67 | 40.00 | 13.38 |
| 541.00 | 6.03 | 0.65 | 0.65 | 46.00 | 11.76 |
| 545.00 | 6.02 | 0.64 | 0.64 | 50.00 | 10.90 |
| 555.00 | 5.97 | 0.59 | 0.59 | 60.00 | 9.25 |
| 565.00 | 5.94 | 0.56 | 0.56 | 70.00 | 8.07 |
| 575.00 | 5.90 | 0.52 | 0.52 | 80.00 | 7.19 |
| 585.00 | 5.89 | 0.51 | 0.51 | 90.00 | 6.50 |
| 615.00 | 5.83 | 0.45 | 0.45 | 120.00 | 5.13 |
| 645.00 | 5.83 | 0.45 | 0.45 | 150.00 | 4.30 |
| 675.00 | 5.73 | 0.35 | 0.35 | 180.00 | 3.75 |
| 735.00 | 5.70 | 0.32 | 0.32 | 240.00 | 3.06 |
| 1122.00 | 5.56 | 0.18 | 0.18 | 627.00 | 1.79 |

023857

STEP DRAWDOWN TEST - WELL ERT-7

OBSERVATION WELL ERT-8A

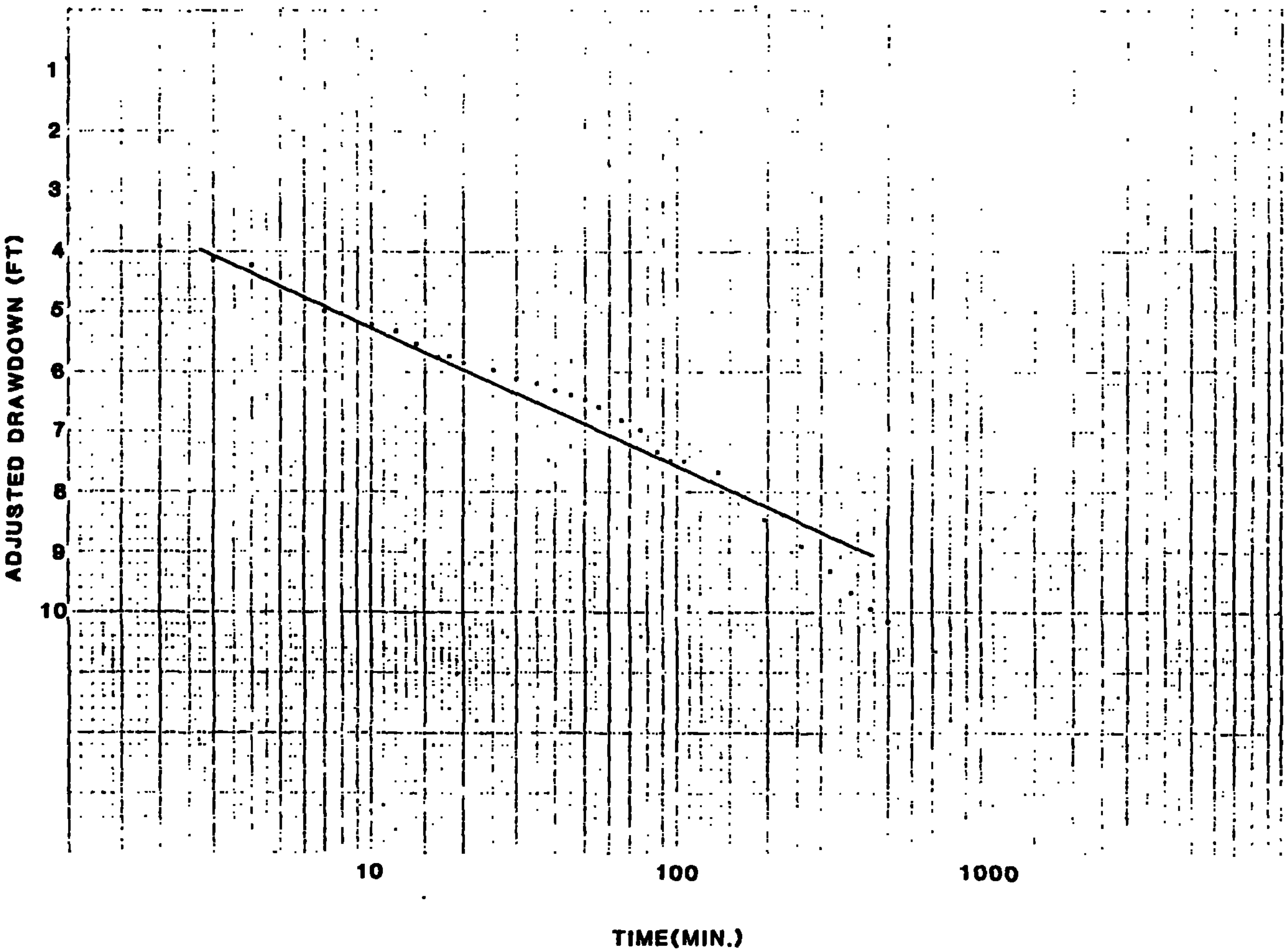
Saturated Thickness 49.66 feet Date: 8/9/88

static water level 4.49 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0.00 | 4.49 | 0.00 | 0.00 | | |
| 0.50 | 5.50 | 1.01 | 1.00 | | |
| 1.00 | 5.50 | 1.01 | 1.00 | | |
| 2.00 | 5.52 | 1.03 | 1.02 | | |
| 3.00 | 5.57 | 1.08 | 1.07 | | |
| 4.00 | 5.61 | 1.12 | 1.11 | | |
| 5.00 | 5.64 | 1.15 | 1.14 | | |
| 6.00 | 5.67 | 1.18 | 1.17 | | |
| 7.00 | 4.70 | 0.21 | 0.21 | | |
| 8.00 | 4.72 | 0.23 | 0.23 | | |
| 10.00 | 5.77 | 1.28 | 1.26 | | |
| 12.00 | 5.81 | 1.32 | 1.30 | | |
| 14.00 | 5.85 | 1.36 | 1.34 | | |
| 16.00 | 5.87 | 1.38 | 1.36 | | |
| 18.00 | 5.90 | 1.41 | 1.39 | | |
| 20.00 | 5.92 | 1.43 | 1.41 | | |
| 25.00 | 5.97 | 1.48 | 1.46 | | |
| 30.00 | 6.01 | 1.52 | 1.50 | | |
| 35.00 | 6.05 | 1.56 | 1.54 | | |
| 40.00 | 6.07 | 1.58 | 1.55 | | |
| 45.00 | 6.10 | 1.61 | 1.58 | | |
| 50.00 | 6.12 | 1.63 | 1.60 | | |
| 55.00 | 6.15 | 1.66 | 1.63 | | |
| 65.00 | 6.19 | 1.70 | 1.67 | | |
| 75.00 | 6.21 | 1.72 | 1.69 | | |
| 86.00 | 6.26 | 1.77 | 1.74 | | |
| 95.00 | 6.28 | 1.79 | 1.76 | | |
| 105.00 | 6.31 | 1.82 | 1.79 | | |
| 135.00 | 6.37 | 1.88 | 1.84 | | |
| 165.00 | 6.41 | 1.92 | 1.88 | | |
| 195.00 | 6.46 | 1.97 | 1.93 | | |
| 255.00 | 6.56 | 2.07 | 2.03 | | |
| 315.00 | 6.63 | 2.14 | 2.09 | | |
| 375.00 | 6.72 | 2.23 | 2.18 | | |
| 435.00 | 6.76 | 2.27 | 2.22 | | |
| 494.00 | 6.80 | 2.31 | 2.26 | | |
| 495.00 | 6.79 | 2.30 | 2.25 | | |
| 498.00 | 6.75 | 2.26 | 2.21 | 3.00 | 166.00 |
| 499.00 | 6.76 | 2.27 | 2.22 | 4.00 | 124.75 |

| | | | | | |
|---|---|---|---|---|---|
| 500.00 | 6.66 | 2.17 | 2.12 | 5.00 | 100.00 |
| 501.00 | 6.62 | 2.13 | 2.08 | 6.00 | 83.50 |
| 502.00 | 6.60 | 2.11 | 2.07 | 7.00 | 71.71 |
| 503.00 | 6.55 | 2.06 | 2.02 | 8.00 | 62.88 |
| 504.00 | 6.54 | 2.05 | 2.01 | 9.00 | 56.00 |
| 505.00 | 6.52 | 2.03 | 1.99 | 10.00 | 50.50 |
| 507.00 | 6.48 | 1.99 | 1.95 | 12.00 | 42.25 |
| 509.00 | 6.45 | 1.96 | 1.92 | 14.00 | 36.36 |
| 511.00 | 6.42 | 1.93 | 1.89 | 16.00 | 31.94 |
| 513.00 | 6.40 | 1.91 | 1.87 | 18.00 | 28.50 |
| 515.00 | 6.38 | 1.89 | 1.85 | 20.00 | 25.75 |
| 520.00 | 6.35 | 1.86 | 1.83 | 25.00 | 20.80 |
| 525.00 | 6.30 | 1.81 | 1.78 | 30.00 | 17.50 |
| 530.00 | 6.27 | 1.78 | 1.75 | 35.00 | 15.14 |
| 535.00 | 6.25 | 1.76 | 1.73 | 40.00 | 13.38 |
| 540.00 | 6.21 | 1.72 | 1.69 | 45.00 | 12.00 |
| 545.00 | 6.20 | 1.71 | 1.68 | 50.00 | 10.90 |
| 550.00 | 6.16 | 1.67 | 1.64 | 55.00 | 10.00 |
| 560.00 | 6.12 | 1.63 | 1.60 | 65.00 | 8.62 |
| 570.00 | 6.10 | 1.61 | 1.58 | 75.00 | 7.60 |
| 580.00 | 6.07 | 1.58 | 1.55 | 85.00 | 6.82 |
| 610.00 | 5.98 | 1.49 | 1.47 | 115.00 | 5.30 |
| 640.00 | 5.94 | 1.45 | 1.43 | 145.00 | 4.41 |
| 670.00 | 5.92 | 1.43 | 1.41 | 175.00 | 3.83 |
| 730.00 | 5.85 | 1.36 | 1.34 | 235.00 | 3.11 |
| 1116.00 | 5.70 | 1.21 | 1.20 | 621.00 | 1.80 |

023859




**PUMPED WELL ERT-7 DRAWDOWN ANALYSIS**

$$T = \frac{264}{s} Q \text{ gpd/ft}$$

$$T = \frac{264(6.67)}{1.2} = 1467 \text{ gpd/ft}$$

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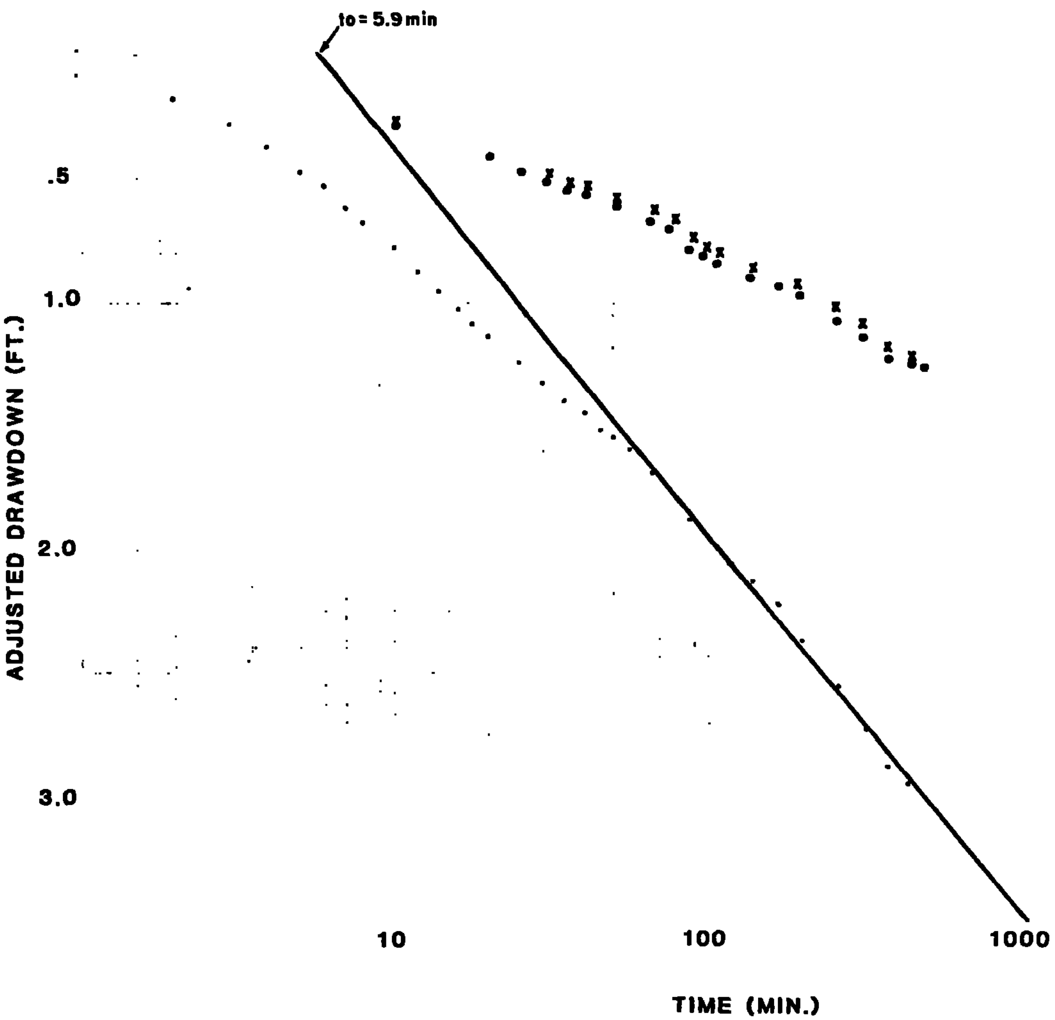
| |
|---|
| **FRENCH LIMITED PROJECT**<br>CROSBY, TEXAS |
| **FIGURE A2-2**<br>SEMI-LOG DRAWDOWN ANALYSIS<br>PUMPED WELL: ERT-7<br>OBSERVATION WELL: ERT-7<br>DATE(S): AUG. 9, 1988 |

| | | |
|---|---|---|
| PROJECT No. 26 | DATE 9/12 | REVISION |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.




**OBSERVATION WELL ERT-8 ANALYSIS**

$T = \frac{264(Q)}{S}$ gpd/ft

$T = \frac{264(6.67)}{1.5} = 1.174$ gpd/ft

$S = \frac{T\ t_o}{4790 r^2}$

$S = \frac{1174(5.9)}{4790(9.2)^2} = .017$

- • WELL ERT-8 (r = 9.2 ft)
- ● WELL ERT-7A (r = 11.2 ft)
- x WELL ERT-8A (r = 14.3 ft)

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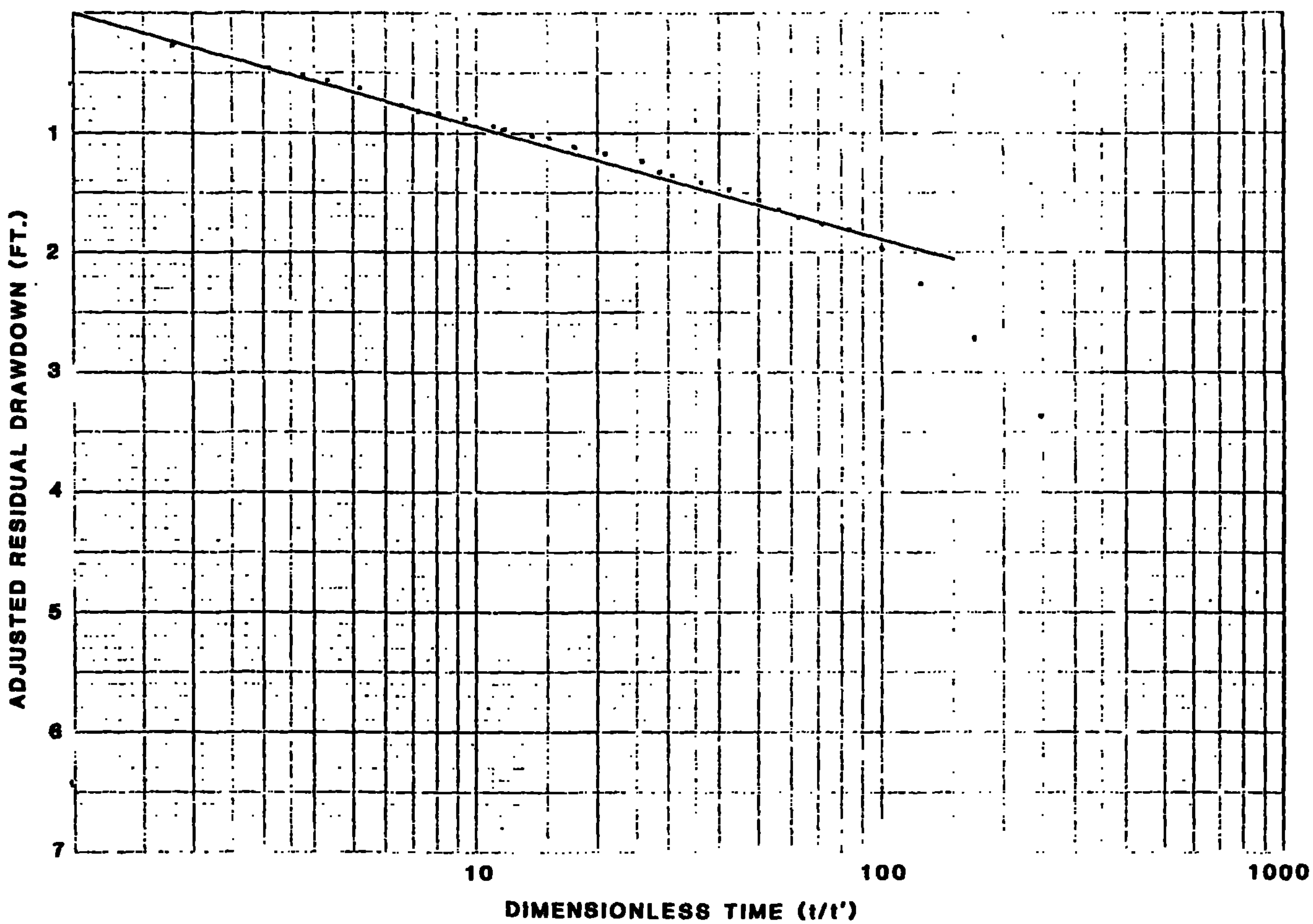
**FRENCH LIMITED PROJECT**
CROSBY, TEXAS

**FIGURE A2-3**
SEMI-LOG DRAWDOWN ANALYSIS

PUMPED WELL: ERT-7
OBSERVATION WELL: ERT-8
DATE(S): AUG. 9, 1988

| PROJECT No. 26 | DATE 9/12 | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.




## PUMPED WELL ERT-7 RECOVERY ANALYSIS

$$T = \frac{264\ Q}{\Delta s}\ \text{gpd/ft}$$

$$T = \frac{264\ (6.67)}{.95} = 1854\ \text{gpd/ft}$$

FRENCH LIMITED PROJECT
CROSBY, TEXAS

**FIGURE A2-4**
THEIS RECOVERY ANALYSIS ERT

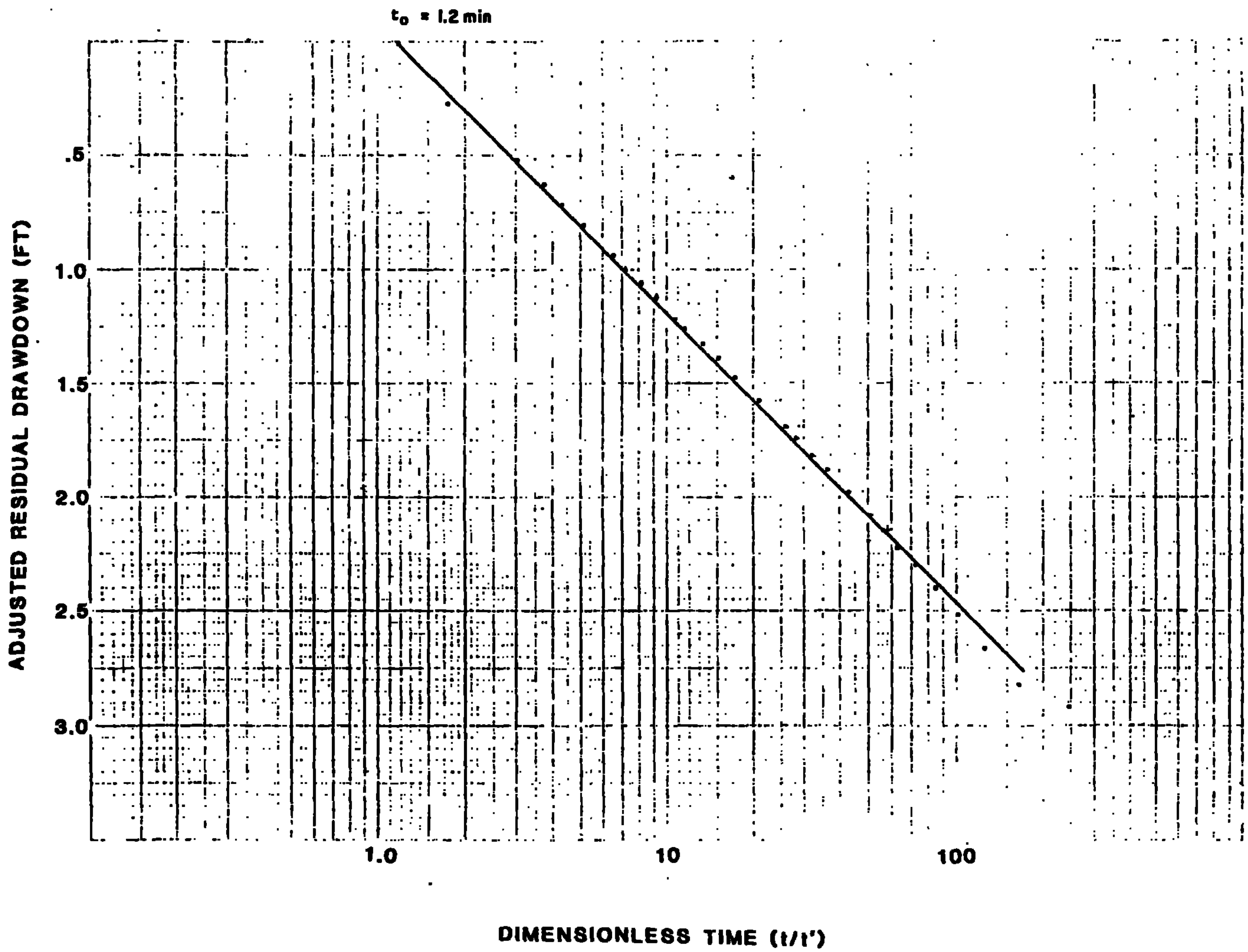
PUMPED WELL : ERT-7
OBSERVATION WELL: ERT-7
DATE(S): AUG. 9, 1988

| PROJECT No. | DATE | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.



023861




## OBSERVATION WELL ERT-8 RECOVERY ANALYSIS

$$T = \frac{264\ Q}{\Delta Sc} = \frac{264\ (6.67)}{1.26}$$

$T$ = 1387 gpd/ft

$$S = \frac{T\ (to)}{4790\ r2}$$

$$= \frac{1387\ (1.2\ \text{min.})}{4790\ (9.2)2}$$

$S$ = .0041



| FRENCH LIMITED PROJECT<br>CROSBY, TEXAS | | |
|---|---|---|
| **FIGURE A2-5**<br>THEIS RECOVERY ANALYSIS<br>PUMPED WELL: ERT-7<br>OBSERVATION WELL: ERT-8<br>DATE(S): AUG. 9, 1988 | | |
| PROJECT No. | DATE 9/12 | REVISION |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 15, 1988

PUMPED WELL: ERT-10

TOTAL DEPTH: 50 FEET

OBSERVATION WELLS: ERT-9, radial distance 9.05 feet,
ERT-9A, radial distance 14.92 feet,
ERT-10A, radial distance 11.31 feet and
REI-10-4, radial distance 44.6 feet

CONTROL WELLS: ERT-1, ERT-1A, ERT-8 and ERT-8A

BACKGROUND AND DESCRIPTION OF TEST:

The test of well ERT-10 was not in the original Work Plan for pump testing the shallow alluvial zone dated June 13, 1988. The original Work Plan called for testing well REI-10-3 located approximately 170 feet west of well ERT-10.

In the review of the work plan, Ms. Kathleen O'Reiley of Region VI of the U.S. EPA expressed concern that well REI-10-3 may not be representative because of the low transmissivity associated with the single well recovery analysis of the short term (15-minute) test performed on May 26, 1988. It was agreed that the contractors to the French Limited Task Group would perform a step drawdown or variable rate test on wells REI-10-2, REI-10-3 and REI-10-4 to help select a well for pumping in a six- to eight- hour test.

The results of these variable rate tests indicated that all three wells were poor producers and transmissivities in the area were quite low. Following discussion of these results with Ms. Kathleen O'Reiley on site on August 11, 1988, it was agreed that AHA and ERT personnel would test either well ERT-9 or ERT-10 rather than one of the wells at the REI-10 cluster. The primary reason for pump testing either well ERT-9 or ERT-10 was to provide information about aquifer characteristics between the low-transmissivity REI-10 well cluster and the higher transmissivity zone around well ERT-7. Well ERT-10 was selected for pumping because it generally produced more water than well ERT-9 when purging the well prior to sampling.

Lithologic and well completion logs and an illustration of the location of the pumped well, ERT-10 and the observation wells precede the aquifer test data which follow.

A preliminary variable rate test was performed on well ERT-10 by Applied Hydrology Associates and ERT personnel on August 12, 1988 in order to select an appropriate pumping rate for the six- to eight-hour test. Water level measurements were taken on the pumped well and on wells ERT-10A, ERT-9 and ERT-9A. It was not possible to set or adjust the flow rate using the in-line Rotometer because water was too turbid and dark to observe the gage. Flow measurements were taken using a five-gallon bucket and stop watch. The well was pumped for 30 minutes at a rate of approximately 0.93 gpm although it was difficult to maintain a constant rate without being able to read the flow meter.

The drawdown after 31 minutes was only 2.33 feet, so the pumping rate was increased to a rate which averaged about 2.14 gpm for the next 35 minutes. An additional 7.14 feet of drawdown occurred after pumping at this rate for 35 minutes. Pumping was terminated and recovery measurements were taken for about four hours after pumping stopped. Field measurements are attached. Water produced from the test was pumped directly into the French Limited Lagoon.

On the basis of the preliminary step test, it was decided to pump at a rate of about 2.14 gpm during the six- to eight-hour test. The valve in the discharge hose was left at the position which produced a rate of 2.14 gpm in the latter portion of the step test, the pump remained in the well over the weekend, and the test was started at 9:00 a.m. on August 15. Because of the difficulty reading the flow meter, flow measurements were taken almost continually with a five-gallon bucket and stop watch.

Prior to pumping the well, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to .01 feet. The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder at the pumped well, at the observation wells and at the control wells.

After about 97 minutes into the test, the drawdown reached the pump level even though the well was pumped at a rate of only about 2.05 gpm. Rather than terminating the test, it was decided to continue pumping at a lower rate. Subsequent measurements with a five-gallon bucket and stop watch showed this pumping rate to average about 0.84 gpm and to range from 0.72 to 1.03 gpm. After pumping at this rate for about 220 minutes, the water levels reached the pump intake and the test personnel were unable to sustain the pumping rate at 0.84 gpm. For the last 113 minutes of the test, the pumping rate averaged about 0.64 gpm and ranged from 0.59 to 0.71 gpm.

Recovery measurements were taken at the pumping well and the observation wells for 342 minutes following termination of pumping.

Drawdown and residual drawdown values determined from water level measurements in wells REI-10-4, ERT-10 and ERT-9 were adjusted using Jacob's (1963) correction to allow the solutions for confined aquifers to better apply to unconfined conditions:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown

s = drawdown and
Ho = initial saturated thickness

The attached data sheets present the measurements for the pumped well and the observation wells during the pump test and recovery period. The data sheets include the observed drawdowns and the corrected drawdowns for wells REI-10-4, ERT-10 and ERT-9.

Water produced from the test was pumped directly into the French Limited Lagoon.

INTERPRETATION:

The control wells ERT-1, ERT-8 and ERT-8a showed a similar diurnal pattern as shown in Figure A2-6. Measurements at control well ERT-1A were not included because organic chemicals in the well precluded precise measurement via a well sounder. The diurnal fluctuation in wells ERT-1, ERT-8 and ERT-8A was approximately 0.1 feet. No precipitation was recorded during the test. The highest water levels appeared between 16:00 and 17:30 (4:00 and 5:30 p.m.) and the lowest levels appeared between 11:00 and 12:00 (11:00 a.m. and 12:00 p.m.) (see attached data sheets and plots).

Because of the relatively small response to pumping as measured at observation well REI-10-4, it was decided to adjust the data for well REI-10-4 for diurnal fluctuations based on the pattern of fluctuations seen in the control wells. The response in wells ERT-9A and ERT-10A was so small (less than .05 feet) that the drawdown response could not be interpreted quantitatively with or without adjustment for the observed diurnal fluctuations. Qualitatively, it is obvious that the lack of a significant response in wells ERT-9A and ERT-10A (located 14.9 and 11.3 ft respectively from the pumped well) is indicative of a vertical hydraulic conductivity that may be several orders of magnitude lower than the horizontal hydraulic conductivity.

An adjustment of water level measurements for the observation well ERT-9 and the pumped well ERT-10 to the fluctuations measured at the control wells was not performed because the diurnal fluctuation in water levels in the control wells was so small relative to the drawdown response in the test wells.

By use of the transmissivity and storage coefficients from the Birsoy and Summers recovery analysis (Figure A2-7), the dimensionless parameter $u = r^2S/4Tt$ at the radius of the observation well, ERT-9 was less than 0.01 after 170 minutes of pumping. Consequently, the constant pumping intervals were still too short to apply semi-log analysis techniques to the drawdown data from well ERT-9. However, the last six recovery measurements were within the range where "u" is less than 0.01.

Based on the "u" parameter criterion, the semi-log technique would apply to nearly the entire data range for the pumped well except that portion subject to well bore storage influences. The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2.1 and shown below:

tc > 0.6(16-1)/(2.05/33.56*) = 147 minutes

* drawdown at time 98 minutes when the pumping rate declined rather that at time.

Drawdown and adjusted drawdown values are included in the attached data sheet. Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data.

The ratio of adjusted drawdown to the associated pumping rate for wells ERT-9 and ERT-10 were plotted against the log of adjusted time on the attached semi-log plots in Figures A2-6 and A2-7. The ratio of the adjusted residual drawdown (recovery) to the final pumping rate were also plotted against the log of dimensionless time on the same semi-log plots. Well bore storage influences would preclude valid application of the Birsoy and Summers technique to the drawdown data. Also, the technique would apply to only the last few recovery data points. Consequently, the single well data were not used to evaluate aquifer characteristics.

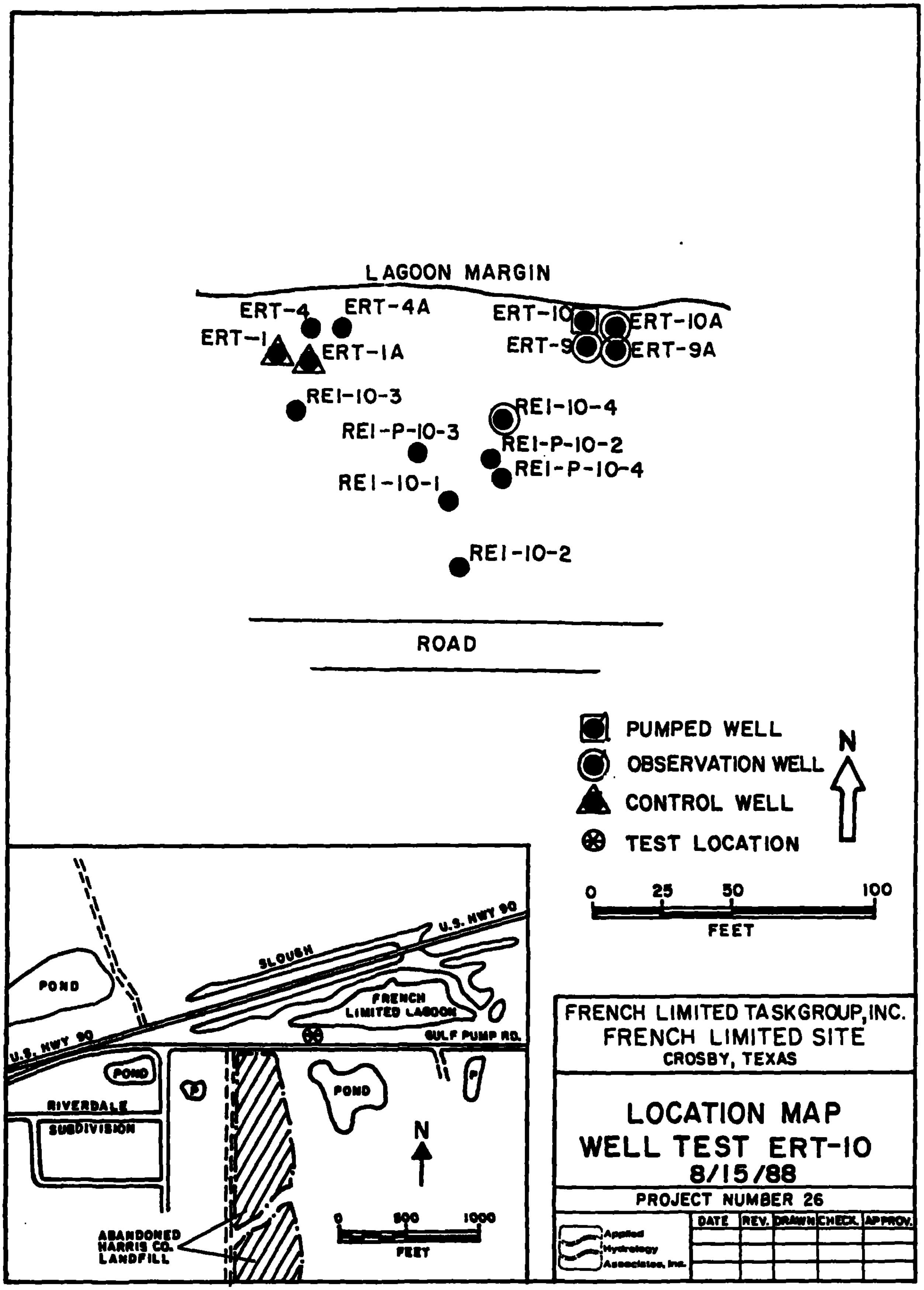
Better results were obtained from the observation well ERT-9. The transmissivity and storage coefficient calculated from the recovery data from the semi-log plots were 754 gpd/ft. and .0058 respectively. The hydraulic conductivity and transmissivity was about 50 percent of the magnitude calculated from the ERT-7 well site but the storage coefficients were similar. Delayed yield effects were not observed but could have been masked by the variable pumping rate.

The u value at the radius of the observation wells REI-10-4 was too large to permit satisfactory application of the semi-log techniques such as that of Birsoy and Summers for variable pumping rates. The dimensionless parameter $u = r^2S/4Tt$ at the radius of the observation well, REI-10-4, located 44.6 ft from the pumped well, was less than 0.01 after 2919 minutes using the transmissivity and storage coefficients from the Boulton Delayed Yield analysis in Figure A2-8. Consequently, the semi-log analysis techniques could not be applied to either the drawdown or recovery data from observation well REI-10-4.

Instead, the Boulton Delayed Yield Analyses was applied to the constant-pumping-rate response observed in well REI-10-4 during the first 95 minutes of pumping. Adjusted drawdown was plotted on log-log paper against time as shown in Figure A2-8. The drawdown response at well REI-10-4 did not follow a Theis response. A good match was obtained using the early test portion of a Boulton Delayed-Yield type curve with r/B equal to 1.5. The calculated transmissivity from the match was 145 gpd/ft and the storage coefficient from the early test match was 0.0008. These results seem reasonable since the hydraulic conductivity decreases in the direction of the REI-10-4 well and the results compare favorably with the results from the step-drawdown test at well REI-10-2.

As indicated previously, the drawdown response in observation wells ERT-9A and ERT-10A were not analyzed quantitatively because of the very small (less than .05 ft.) response in these wells.

023867


LAGOON MARGIN
ERT-4
ERT-4A
ERT-1
ERT-1A
ERT-10
ERT-10A
ERT-9
ERT-9A
REI-10-3
REI-10-4
REI-P-10-3
REI-P-10-2
REI-P-10-4
REI-10-1
REI-10-2
ROAD
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 25 50 100
FEET
POND
SLOUGH
U.S. HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
RIVERDALE
SUBDIVISION
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-10
8/15/88
PROJECT NUMBER 26
DATE
REV.
DRAWN
CHECK.
APPROV.
Applied Hydrology Associates, Inc.

023868

# ERT

A RESOURCE ENGINEERING COMPANY



## BORING LOG AND CONSTRUCTION OF ERT-10

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-10
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

**DRILLING AND SAMPLING INFORMATION**

Date Started: 11-14-87 Date Completed: 11-14-87
Method: Mud Rotary Total Depth: 49.5 feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch Ø Length: 30.0 feet
Slot Size: 0.010 inch Type: PVC
Casing Dia.: 4-inch Ø Length: 20.0 feet

SURFACE ELEVATION

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Road fill material (1.0') | | | | | | | | | |
| | Gray silty medium to fine sand (33.0') | | | | | | | | | |
| | Gray fine to medium sandy silt with clay lenses (35.0') | 10 | S.S. | 35 | | - | 100 | 3-12 | | |
| | - Gray coarse sand and gravel (52.0') | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

**ERT** 023869

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-9

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-9
Logged By: Steve Preston
Approved By:
Drilled By: FSI, Inc. Driller's Name: R. Preston

DRILLING AND SAMPLING INFORMATION
Date Started: 11-15-87 Date Completed: 11-15-87
Method: Mud Rotary Total Depth: 54.5 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch Ø Length: 30.0 feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch Ø Length: 22.0 feet

| DEPTH IN FEET | DESCRIPTION | | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | | |
| 0 | Road fill material | (1.0') | | | | | | | | | |
| | Gray fine to medium silty sand | | | | | | | | | | |
| | - Medium to coarse sand | | | | | | | | | | |
| | | (52.5') ~~(52.0')~~ | | | | | | | | | |
| | - Gray fine silty sand<br>- Gray silty clay | (54.5') | 9 | SS | 54.5 | - | | 100 | - | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

ERT 023870

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-9A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-9A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

DRILLING AND SAMPLING INFORMATION
Date Started: 11-15-87 Date Completed: 11-15-87
Method: Mud Rotary Total Depth: 20.0 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch Ø Length: 15.0 feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch Ø Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.5') | | | | | | | | | |
| | Gray medium to fine silty sand (23.0') | | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

**ERT** 023871

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-10A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-10A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

DRILLING AND SAMPLING INFORMATION
Date Started: 11-17-87 Date Completed: 11-17-87
Method: Mud Rotary Total Depth: 20.0 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch ∅ Length: 15.0 feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch ∅ Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Road fill material (1.0') | | | | | | | |  | |
| | Gray medium to fine silty sand (23.0') | | | | | | | | | |

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023872

# RESOURCE ENGINEERING

## SUBSURFACE EXPLORATION

Sheet 1 of 1

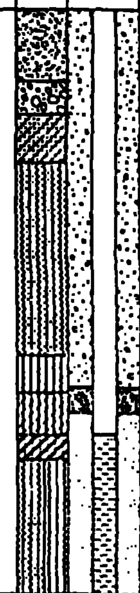
# LITHOLOGIC LOG AND CONSTRUCTION OF REI 10-4

Client: FRENCH LTD. TASK GROUP
Project Name: French Ltd. 1986 F.I.
Project Location: Crosby, Texas
Job No.: 275-14 Boring No.: 10-4
Logged By: S. L. Baird
Approved By:
Drilled By: SWL

**DRILLING AND SAMPLING INFORMATION**
Date Started: 7/28/86 Date Completed: 7/28/86
Method: MR Total Depth: 48.0 FEET

**WELL COMPLETION INFORMATION**
Screen Dia.: 4" Length: 12.80'
Slot Size: 0.010" Type: PVC
Casing Dia.: 4" Length: 36.99

| DEPTH IN FEET | DESCRIPTION | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION 14.40 | | | | | | | |
| 0 | SURFACE FILL, rubber | 8.4 | | | | | | |
| | SAND AND GRAVEL | 5.9 | | | | | | |
| 10 | CLAYEY SAND | 1.9 | | | | | | |
| 20 | SILTY SAND | -14.1 | | | | | | |
| 30 | SANDY SILT | -17.1 | | | | | | |
| | CLAYEY SILT | -20.6 | | | | | | |
| | SLIGHTLY SILTY CLAY | -22.6 | | | | | | |
| 40 | SILTY SAND/SANDY SILT | -33.6 | | | | | | |
| 50 | TD 48.0 BORING (8") DRILLED TO 48.0'. ELECTRIC LOGGED AND COMPARED WITH CONTINUOUS SAMPLE LOG FROM ADJACENT 10-1. FOUR INCH MONITOR WELL SET WITH FLUSH VALVE, 4" SCH 40 PVC FLUSH JOINTED CASING AND 0.010" SLOT SCREEN #3 SAND USED IN SAND PACK, 1/2" BENTONITE PELLETS IN SEAL. GROUTED TO SURFACE WITH CEMENT/BENTONITE SLURRY. WELL CAPPED AND VENTED. ELEVATION OF TOP OF CASING SURVEYED. | | | | | | | |



**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

**ERT** 023873

A RESOURCE ENGINEERING COMPANY

FIGURE 4-3

# LITHOLOGIC LOG AND CONSTRUCTION OF MW- ERT 1

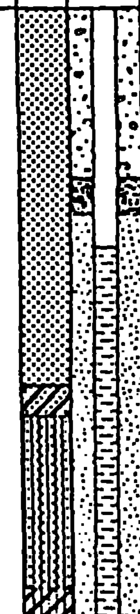
Sheet 1 of 1

Client: French Ltd. Task Group
Project Name: Bioremediation
Project Location: Crosby, TX
Job No: 275-21  MW: ERT 1
Logged By: SLB
Approved By:
Drilled By: JS

DRILLING AND SAMPLING INFORMATION
Date Started: 3/11/87  Date Completed: 3/11/87
Method: RW  Total Depth: 50 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4"  Length: 30 feet
Slot Size: 0.010"  Type: PVC
Casing Dia.: 4"  Length: 20 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLED INTERVALS, HNU READINGS | STRATUM ELEVATION IN FEET | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | |
| 10 | SILTY SAND-gray, medium to fine grain, wet, asorted multicolored fines,odor | | | | | | | | |
| 20 | thin gravel ledge. slight odor, dark gray sludge | | | | | | | | |
| 30 | SANDY CLAY-gray, multicolor gravels washing from above | | | | | | | | |
| 40 | SANDY SILT & SILTY SAND-tan, strong odor | | | | | | | | |
| 50 | VERY SILTY CLAY-gray and white ,odor | | | | | | | | |



FORMATION CHANGES INTERPRETED BY CHANGES IN DRILLING RATE,CUTTINGS IN MUD PIT, AND LOGS FROM ADJACENT WELLS. WELL BORE WASHED TO 50 FEET WITH A ROTARY WASH DRILLING RIG USING A SODIUM BENTONITE MUD. CASING INSTALLED, SAND PACKED AND SEALED WITH 1/2" BENTONITE PELLETS, PRESSURE GROUTED TO THE SURFACE WITH CLASS 1 CEMENT/BENTONITE SLURRY VIA TREMIE PIPE. WELL CAPPED, VENTED, NOTCHED AND COVERED WITH A CAST IRON STANDPIPE.

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON  CC-CONTINUOUS CORNER
ST - PRESSED SHELBY TUBE  CS-CALIFORNIA SAMPLER

BORING METHOD
HSA - HOLLOW STEM AUGERS  AR-AIR ROTARY
CFA - CONTINUOUS FLIGHT AUGERS  RW-ROTARY WASH

ERT 023874

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-1A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-1A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

DRILLING AND SAMPLING INFORMATION

Date Started: 11-17-87 Date Completed: 11-17-87
Method: Mud Rotary Total Depth: 20.0 feet

WELL COMPLETION INFORMATION

Screen Dia.: 4-inch Ø Length: 15.0 feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch Ø Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.²) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Road fill material (1.5') | | | | | | | | | |
| | Gray fine to medium silty sand | | | | | | | | | |
| 12 | - Gray fine to medium silty sand | 1-A | S.S. | 13 | | - | 100 | 1-2 | | |
| 20 | (20.0') | | | | | | | | | |

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023875

**ERT.**
A RESOURCE ENGINEERING COMPANY



## SUBSURFACE EXPLORATION LITHOGRAPHIC LOG OF ERT-8

Client : French LTD.
Project Name : French LTD.
Project Location : Crosby, Texas
Job Number : 275-21 Boring No : ert-8
Logged By : D. Morgan
Approved By : G. Spradley
Drilled By : Gulf Coast Coring

**DRILLING AND SAMPLING INFORMATION**

Date Started : 9/28/87 Date Completed : 9/28/87
Method : MR Total Depth : 50'

**WELL COMPLETION INFORMATION**

Screen Dia : 4" Length : 29.5'
Slot Size : .010 Type : PVC
Casing Dia : 4" Length : 19.6'

| DEPTH IN FEET | DESCRIPTION<br>SURFACE ELEVATION : | SAMPLE NO. | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fill, roadbase, gravel, silt, sand | | | | | | | | | |
| 5 | Silty Sand, gray | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | Sand, fine to medium grained | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | Clayey Silt, gray, some odor | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| | Silty Clay, light gray, some tan mottles | 1 | SS | 50 | - | | | | | |
| 50 | Stratigraphic breaks determined by advance of boring, cuttings, and information obtained from adjacent well ERT-7 | | | | | | | | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE

BORING METHOD

HSA - HOLLOW STEM AUGER
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

ERT 023876

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-8A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01  Boring No.: ERT-8A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc.  Driller's Name: R. Spencer

**DRILLING AND SAMPLING INFORMATION**

Date Started: 11-17-87  Date Completed: 11-17-87
Method: Mud Rotary  Total Depth: 20.5 feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch Ø  Length: 15.0 feet
Slot Size: 0.010-inch  Type: PVC
Casing Dia.: 4-inch Ø  Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.0') | | | | | | | | | |
| | - Gray sandy clay | | | | | | | | | |
| | - Gray fine to medium silty sand | | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | (22.0') | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

02?877

ERT-10 Aquifer Pump Test
Control Well Water Level Fluctuations

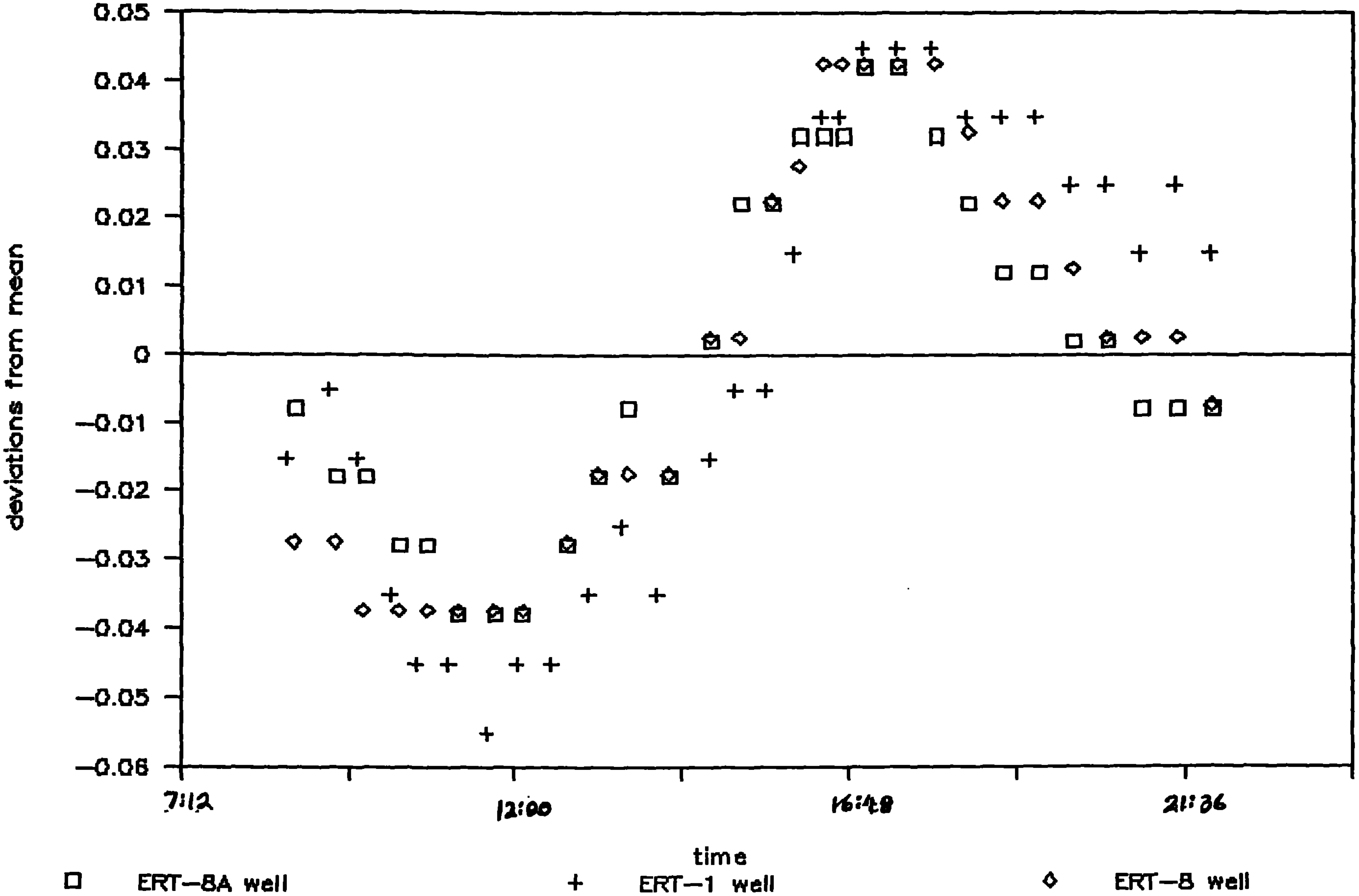
| hour | minute | ERT-8A | mean-dev ERT-8A 5.15 | ERT-1 | mean-dev ERT-1 6.30 | ERT-8 | mean-dev ERT-8 4.50 |
|---|---|---|---|---|---|---|---|
| 11.00 | 1.00 | | | 6.35 | -0.05 | | |
| 10.00 | 33.00 | | | 6.35 | -0.05 | | |
| 10.00 | 11.00 | | | 6.34 | -0.04 | | |
| 9.00 | 43.00 | | | 6.32 | -0.02 | | |
| 8.00 | 42.00 | | | 6.32 | -0.02 | | |
| 9.00 | 18.00 | | | 6.31 | -0.01 | | |
| 11.00 | 34.00 | | | 6.36 | -0.06 | | |
| 12.00 | 2.00 | | | 6.35 | -0.05 | | |
| 12.00 | 32.00 | | | 6.35 | -0.05 | | |
| 13.00 | 4.00 | | | 6.34 | -0.04 | | |
| 13.00 | 31.00 | | | 6.33 | -0.03 | | |
| 14.00 | 3.00 | | | 6.34 | -0.04 | | |
| 14.00 | 47.00 | | | 6.32 | -0.02 | | |
| 15.00 | 8.00 | | | 6.31 | -0.01 | | |
| 15.00 | 34.00 | | | 6.31 | -0.01 | | |
| 15.00 | 58.00 | | | 6.29 | 0.01 | | |
| 16.00 | 21.00 | | | 6.27 | 0.03 | | |
| 16.00 | 37.00 | | | 6.27 | 0.03 | | |
| 16.00 | 57.00 | | | 6.26 | 0.04 | | |
| 17.00 | 26.00 | | | 6.26 | 0.04 | | |
| 17.00 | 56.00 | | | 6.26 | 0.04 | | |
| 18.00 | 26.00 | | | 6.27 | 0.03 | | |
| 18.00 | 56.00 | | | 6.27 | 0.03 | | |
| 19.00 | 26.00 | | | 6.27 | 0.03 | | |
| 19.00 | 56.00 | | | 6.28 | 0.02 | | |
| 20.00 | 26.00 | | | 6.28 | 0.02 | | |
| 20.00 | 56.00 | | | 6.29 | 0.01 | | |
| 21.00 | 26.00 | | | 6.28 | 0.02 | | |
| 21.00 | 56.00 | | | 6.29 | 0.01 | | |
| 10.00 | 42.00 | | | | | 4.54 | -0.04 |
| 10.00 | 18.00 | | | | | 4.54 | -0.04 |
| 9.00 | 48.00 | | | | | 4.54 | -0.04 |
| 9.00 | 24.00 | | | | | 4.53 | -0.03 |
| 8.00 | 49.00 | | | | | 4.53 | -0.03 |
| 11.00 | 8.00 | | | | | 4.54 | -0.04 |
| 11.00 | 40.00 | | | | | 4.54 | -0.04 |
| 12.00 | 7.00 | | | | | 4.54 | -0.04 |
| 12.00 | 45.00 | | | | | 4.53 | -0.03 |
| 13.00 | 11.00 | | | | | 4.52 | -0.02 |
| 13.00 | 37.00 | | | | | 4.52 | -0.02 |
| 14.00 | 12.00 | | | | | 4.52 | -0.02 |
| 14.00 | 47.00 | | | | | 4.50 | 0.00 |
| 15.00 | 12.00 | | | | | 4.50 | 0.00 |
| 15.00 | 39.00 | | | | | 4.48 | 0.02 |
| 16.00 | 3.00 | | | | | 4.48 | 0.03 |
| 16.00 | 24.00 | | | | | 4.46 | 0.04 |
| 16.00 | 40.00 | | | | | 4.46 | 0.04 |
| 16.00 | 59.00 | | | | | 4.46 | 0.04 |
| 17.00 | 28.00 | | | | | 4.46 | 0.04 |

023878

| hour | minute | ERT-8A | mean-dev ERT-8A 5.15 | ERT-1 | mean-dev ERT-1 6.30 | ERT-8 | mean-dev ERT-8 4.50 |
|---|---|---|---|---|---|---|---|
| 18.00 | 0.00 | | | | | 4.46 | 0.04 |
| 18.00 | 28.00 | | | | | 4.47 | 0.03 |
| 18.00 | 58.00 | | | | | 4.48 | 0.02 |
| 19.00 | 28.00 | | | | | 4.48 | 0.02 |
| 19.00 | 58.00 | | | | | 4.49 | 0.01 |
| 20.00 | 28.00 | | | | | 4.50 | 0.00 |
| 20.00 | 58.00 | | | | | 4.50 | 0.00 |
| 21.00 | 28.00 | | | | | 4.50 | 0.00 |
| 21.00 | 58.00 | | | | | 4.51 | -0.01 |
| 10.00 | 19.00 | 5.18 | -0.03 | | | | |
| 10.00 | 42.00 | 5.18 | -0.03 | | | | |
| 9.00 | 50.00 | 5.17 | -0.02 | | | | |
| 9.00 | 25.00 | 5.17 | -0.02 | | | | |
| 8.00 | 50.00 | 5.16 | -0.01 | | | | |
| 11.00 | 9.00 | 5.19 | -0.04 | | | | |
| 11.00 | 41.00 | 5.19 | -0.04 | | | | |
| 12.00 | 7.00 | 5.19 | -0.04 | | | | |
| 12.00 | 45.00 | 5.18 | -0.03 | | | | |
| 13.00 | 12.00 | 5.17 | -0.02 | | | | |
| 13.00 | 37.00 | 5.16 | -0.01 | | | | |
| 14.00 | 13.00 | 5.17 | -0.02 | | | | |
| 14.00 | 48.00 | 5.15 | 0.00 | | | | |
| 15.00 | 13.00 | 5.13 | 0.02 | | | | |
| 15.00 | 40.00 | 5.13 | 0.02 | | | | |
| 16.00 | 4.00 | 5.12 | 0.03 | | | | |
| 16.00 | 25.00 | 5.12 | 0.03 | | | | |
| 16.00 | 41.00 | 5.12 | 0.03 | | | | |
| 17.00 | 0.00 | 5.11 | 0.04 | | | | |
| 17.00 | 29.00 | 5.11 | 0.04 | | | | |
| 18.00 | 1.00 | 5.12 | 0.03 | | | | |
| 18.00 | 29.00 | 5.13 | 0.02 | | | | |
| 18.00 | 59.00 | 5.14 | 0.01 | | | | |
| 19.00 | 29.00 | 5.14 | 0.01 | | | | |
| 19.00 | 59.00 | 5.15 | 0.00 | | | | |
| 20.00 | 29.00 | 5.15 | 0.00 | | | | |
| 20.00 | 59.00 | 5.16 | -0.01 | | | | |
| 21.00 | 29.00 | 5.16 | -0.01 | | | | |
| 21.00 | 59.00 | 5.16 | -0.01 | | | | |
| 10.00 | 8.00 | | | | | | |
| 9.00 | 40.00 | | | | | | |
| 10.00 | 31.00 | | | | | | |
| 8.00 | 46.00 | | | | | | |
| 9.00 | 20.00 | | | | | | |
| 11.00 | 4.00 | | | | | | |

# ERT-10 Aquifer Pump Test

Control Well Water Level Fluctuations




B-238

023879

STEP DRAWDOWN TEST - WELL ERT 10

Saturated Thickness 50 feet

static water level 5.74 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti | ADJUSTED TIME min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 5.74 | 0.00 | 0.00 | | 0.00 | 0.00 | | |
| 1.00 | 7.68 | 1.94 | 1.90 | | 1.00 | 0.93 | | |
| 2.00 | 8.16 | 2.42 | 2.36 | | 2.00 | 1.15 | | |
| 3.00 | 8.40 | 2.66 | 2.59 | | 3.00 | 1.26 | | |
| 4.00 | 8.57 | 2.83 | 2.75 | | 4.00 | 1.34 | | |
| 5.00 | 8.70 | 2.96 | 2.87 | | 5.00 | 1.40 | | |
| 6.00 | 8.80 | 3.06 | 2.97 | | 6.00 | 1.45 | | |
| 7.00 | 8.86 | 3.12 | 3.02 | | 7.00 | 1.47 | | |
| 8.00 | 9.12 | 3.38 | 3.27 | | 8.00 | 1.59 | | |
| 9.00 | 9.16 | 3.42 | 3.30 | | 9.00 | 1.61 | | |
| 10.00 | 10.20 | 4.46 | 4.26 | | 10.00 | 2.08 | | |
| 11.00 | 11.27 | 5.53 | 5.22 | | 11.00 | 2.55 | | |
| 12.00 | 11.84 | 6.10 | 5.73 | | 12.00 | 2.79 | | |
| 13.00 | 12.42 | 6.68 | 6.23 | | 13.00 | 3.04 | | |
| 14.00 | 13.02 | 7.28 | 6.75 | | 14.00 | 3.29 | | |
| 15.00 | 13.58 | 7.84 | 7.23 | | 15.00 | 3.52 | | |
| 20.00 | 16.08 | 10.34 | 9.27 | | 20.00 | 4.52 | | |
| 25.00 | 17.38 | 11.64 | 10.29 | | 25.00 | 5.02 | | |
| 30.00 | 18.47 | 12.73 | 11.11 | | 30.00 | 5.42 | | |
| 35.00 | 19.67 | 13.93 | 11.99 | | 35.00 | 5.85 | | |
| 40.00 | 20.95 | 15.21 | 12.90 | | 40.00 | 6.29 | | |
| 70.00 | 29.02 | 23.28 | 17.86 | | 70.00 | 8.71 | | |
| 75.00 | 31.07 | 25.33 | 18.91 | | 75.00 | 9.23 | | |
| 80.00 | 33.25 | 27.51 | 19.94 | | 80.00 | 9.73 | | |
| 85.00 | 36.20 | 30.46 | 21.18 | | 85.00 | 10.33 | | |
| 88.00 | 37.82 | 32.08 | 21.79 | | 88.00 | 10.63 | | |
| 90.00 | 39.20 | 33.46 | 22.26 | | 90.00 | 10.86 | | |
| 98.50 | 39.30 | 33.56 | 22.30 | 1.50 | 40858.12 | 26.54 | | |
| 100.00 | 37.82 | 32.08 | 21.79 | 3.00 | 15619.62 | 25.94 | | |
| 105.00 | 33.97 | 28.23 | 20.26 | 8.00 | 4283.36 | 24.12 | | |
| 110.00 | 31.15 | 25.41 | 18.95 | 13.00 | 2384.30 | 22.56 | | |
| 115.00 | 29.90 | 24.16 | 18.32 | 18.00 | 1663.01 | 21.81 | | |
| 120.00 | 29.42 | 23.68 | 18.07 | 23.00 | 1296.15 | 21.51 | | |
| 125.00 | 29.05 | 23.31 | 17.88 | 28.00 | 1078.60 | 21.28 | | |
| 130.00 | 28.90 | 23.16 | 17.80 | 33.00 | 936.80 | 21.19 | | |
| 135.00 | 29.35 | 23.61 | 18.04 | 38.00 | 838.28 | 21.47 | | |
| 140.00 | 29.47 | 23.73 | 18.10 | 43.00 | 766.66 | 21.55 | | |
| 145.00 | 29.50 | 23.76 | 18.11 | 48.00 | 712.82 | 21.57 | | |
| 150.00 | 29.60 | 23.86 | 18.17 | 53.00 | 671.31 | 21.63 | | |
| 155.00 | 29.60 | 23.86 | 18.17 | 58.00 | 638.67 | 21.63 | | |
| 160.00 | 29.92 | 24.18 | 18.33 | 63.00 | 612.63 | 21.83 | | |
| 170.00 | 30.20 | 24.46 | 18.48 | 73.00 | 574.49 | 22.00 | | |
| 180.00 | 30.62 | 24.88 | 18.69 | 83.00 | 548.97 | 22.25 | | |
| 190.00 | 30.93 | 25.19 | 18.84 | 93.00 | 531.73 | 22.43 | | |

023881

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti | ADJUSTED TIME min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 200.00 | 31.96 | 26.22 | 19.35 | 103.00 | 520.19 | 23.03 | | |
| 210.00 | 32.85 | 27.11 | 19.76 | 113.00 | 512.76 | 23.52 | | |
| 220.00 | 33.68 | 27.94 | 20.13 | 123.00 | 508.36 | 23.97 | | |
| 230.00 | 34.35 | 28.61 | 20.42 | 133.00 | 506.27 | 24.32 | | |
| 240.00 | 35.21 | 29.47 | 20.79 | 143.00 | 505.99 | 24.74 | | |
| 250.00 | 36.05 | 30.31 | 21.12 | 153.00 | 507.13 | 25.15 | | |
| 260.00 | 36.73 | 30.99 | 21.39 | 163.00 | 509.43 | 25.46 | | |
| 270.00 | 38.04 | 32.30 | 21.87 | 173.00 | 512.66 | 26.03 | | |
| 280.00 | 38.84 | 33.10 | 22.14 | 183.00 | 516.68 | 26.36 | | |
| 292.00 | 38.75 | 33.01 | 22.11 | 195.00 | 522.36 | 26.33 | | |
| 304.50 | 38.74 | 33.00 | 22.11 | 207.50 | 529.09 | 26.32 | | |
| 314.00 | 39.68 | 33.94 | 22.42 | 217.00 | 534.67 | 26.69 | | |
| 320.00 | 39.74 | 34.00 | 22.44 | 3.00 | 2725.49 | 35.06 | | |
| 330.00 | 39.23 | 33.49 | 22.27 | 13.00 | 1750.76 | 34.80 | | |
| 340.00 | 39.41 | 33.67 | 22.33 | 23.00 | 1488.73 | 34.90 | | |
| 350.00 | 39.32 | 33.58 | 22.30 | 33.00 | 1352.17 | 34.85 | | |
| 360.00 | 40.20 | 34.46 | 22.59 | 43.00 | 1266.10 | 35.29 | | |
| 370.00 | 40.20 | 34.46 | 22.59 | 53.00 | 1206.60 | 35.29 | | |
| 400.00 | 40.25 | 34.51 | 22.60 | 83.00 | 1105.44 | 35.31 | | |
| 430.00 | 40.25 | 34.51 | 22.60 | 113.00 | 1058.63 | 35.31 | | |
| 431.45 | 39.30 | 33.56 | 22.30 | 1.45 | 729.06 | 34.84 | 1.45 | 297.55 |
| 431.75 | 39.00 | 33.26 | 22.20 | 1.75 | 603.90 | 34.68 | 1.75 | 246.71 |
| 432.88 | 38.00 | 32.26 | 21.85 | 2.88 | 366.57 | 34.15 | 2.88 | 150.31 |
| 434.02 | 37.00 | 31.26 | 21.49 | 4.02 | 262.34 | 33.58 | 4.02 | 107.97 |
| 435.08 | 36.00 | 30.26 | 21.10 | 5.08 | 207.41 | 32.97 | 5.08 | 85.65 |
| 436.50 | 35.00 | 29.26 | 20.70 | 6.50 | 161.90 | 32.34 | 6.50 | 67.15 |
| 437.82 | 34.00 | 28.26 | 20.27 | 7.82 | 134.42 | 31.68 | 7.82 | 55.99 |
| 439.13 | 33.00 | 27.26 | 19.83 | 9.13 | 115.01 | 30.98 | 9.13 | 48.10 |
| 440.50 | 32.00 | 26.26 | 19.36 | 10.50 | 99.90 | 30.26 | 10.50 | 41.95 |
| 442.90 | 31.00 | 25.26 | 18.88 | 12.90 | 81.17 | 29.50 | 12.90 | 34.33 |
| 443.33 | 30.00 | 24.26 | 18.37 | 13.33 | 78.53 | 28.71 | 13.33 | 33.26 |
| 446.43 | 28.00 | 22.26 | 17.30 | 16.43 | 63.58 | 27.04 | 16.43 | 27.17 |
| 449.50 | 26.00 | 20.26 | 16.16 | 19.50 | 53.47 | 25.24 | 19.50 | 23.05 |
| 451.60 | 24.00 | 18.26 | 14.93 | 21.60 | 48.21 | 23.32 | 21.60 | 20.91 |
| 454.97 | 22.00 | 16.26 | 13.62 | 24.97 | 41.63 | 21.28 | 24.97 | 18.22 |
| 460.50 | 20.00 | 14.26 | 12.23 | 30.50 | 33.99 | 19.10 | 30.50 | 15.10 |
| 466.08 | 18.00 | 12.26 | 10.76 | 36.08 | 28.67 | 16.81 | 36.08 | 12.92 |
| 473.17 | 16.00 | 10.26 | 9.21 | 43.17 | 23.91 | 14.39 | 43.17 | 10.96 |
| 481.92 | 14.00 | 8.26 | 7.58 | 51.92 | 19.85 | 11.84 | 51.92 | 9.28 |
| 493.42 | 12.00 | 6.26 | 5.87 | 63.42 | 16.23 | 9.17 | 63.42 | 7.78 |
| 500.50 | 11.00 | 5.26 | 4.98 | 70.50 | 14.60 | 7.79 | 70.50 | 7.10 |
| 508.83 | 10.00 | 4.26 | 4.08 | 78.83 | 13.06 | 6.37 | 78.83 | 6.45 |
| 519.17 | 9.00 | 3.26 | 3.15 | 89.17 | 11.56 | 4.93 | 89.17 | 5.82 |
| 533.87 | 8.00 | 2.26 | 2.21 | 103.87 | 9.95 | 3.45 | 103.87 | 5.14 |
| 552.53 | 7.00 | 1.26 | 1.24 | 122.53 | 8.48 | 1.94 | 122.53 | 4.51 |
| 562.83 | 6.60 | 0.86 | 0.85 | 132.83 | 7.85 | 1.33 | 132.83 | 4.24 |
| 588.25 | 6.00 | 0.26 | 0.26 | 158.25 | 6.66 | 0.41 | 158.25 | 3.72 |
| 622.00 | 5.85 | 0.11 | 0.11 | 192.00 | 5.58 | 0.17 | 192.00 | 3.24 |
| 652.00 | 5.83 | 0.09 | 0.09 | 222.00 | 4.90 | 0.14 | 222.00 | 2.94 |
| 682.00 | 5.81 | 0.07 | 0.07 | 252.00 | 4.40 | 0.11 | 252.00 | 2.71 |
| 712.00 | 5.81 | 0.07 | 0.07 | 282.00 | 4.00 | 0.11 | 282.00 | 2.52 |
| 742.00 | 5.80 | 0.06 | 0.06 | 312.00 | 3.69 | 0.09 | 312.00 | 2.38 |
| 772.00 | 5.80 | 0.06 | 0.06 | 342.00 | 3.43 | 0.09 | 342.00 | 2.26 |

STEP DRAWDOWN TEST - WELL ERT 10

OBSERVATION WELL - ERT-9

Saturated Thickness 50 feet

static water level 5.55 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti | ADJUSTED TIME min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 5.55 | 0.00 | 0.00 | | 0.00 | 0.00 | | |
| 4.50 | 5.82 | 0.27 | 0.27 | | 4.50 | 0.13 | | |
| 11.50 | 6.08 | 0.53 | 0.53 | | 11.50 | 0.26 | | |
| 15.50 | 6.31 | 0.76 | 0.75 | | 15.50 | 0.37 | | |
| 20.50 | 6.49 | 0.94 | 0.93 | | 20.50 | 0.45 | | |
| 25.50 | 6.60 | 1.05 | 1.04 | | 25.50 | 0.51 | | |
| 30.50 | 6.66 | 1.11 | 1.10 | | 30.50 | 0.54 | | |
| 35.50 | 6.72 | 1.17 | 1.16 | | 35.50 | 0.56 | | |
| 40.50 | 6.78 | 1.23 | 1.21 | | 40.50 | 0.59 | | |
| 45.50 | 6.82 | 1.27 | 1.25 | | 45.50 | 0.61 | | |
| 50.50 | 6.85 | 1.30 | 1.28 | | 50.50 | 0.63 | | |
| 55.50 | 6.87 | 1.32 | 1.30 | | 55.50 | 0.64 | | |
| 60.50 | 6.91 | 1.36 | 1.34 | | 60.50 | 0.65 | | |
| 70.50 | 6.96 | 1.41 | 1.39 | | 70.50 | 0.68 | | |
| 80.50 | 6.98 | 1.43 | 1.41 | | 80.50 | 0.69 | | |
| 90.50 | 6.96 | 1.41 | 1.39 | | 90.50 | 0.68 | | |
| 100.50 | 6.90 | 1.35 | 1.33 | 3.50 | 12662.56 | 1.59 | | |
| 105.50 | 6.82 | 1.27 | 1.25 | 8.50 | 3970.94 | 1.49 | | |
| 110.50 | 6.76 | 1.21 | 1.20 | 13.50 | 2283.27 | 1.42 | | |
| 115.50 | 6.71 | 1.16 | 1.15 | 18.50 | 1615.67 | 1.36 | | |
| 120.50 | 6.67 | 1.12 | 1.11 | 23.50 | 1269.43 | 1.32 | | |
| 125.50 | 6.63 | 1.08 | 1.06 | 28.50 | 1061.75 | 1.27 | | |
| 130.50 | 6.60 | 1.05 | 1.04 | 33.50 | 925.35 | 1.24 | | |
| 135.50 | 6.58 | 1.03 | 1.02 | 38.50 | 830.10 | 1.21 | | |
| 140.50 | 6.57 | 1.02 | 1.01 | 43.50 | 760.59 | 1.20 | | |
| 145.50 | 6.55 | 1.00 | 0.99 | 48.50 | 708.18 | 1.18 | | |
| 150.50 | 6.54 | 0.99 | 0.98 | 53.50 | 667.69 | 1.17 | | |
| 155.50 | 6.53 | 0.98 | 0.97 | 58.50 | 635.80 | 1.16 | | |
| 160.50 | 6.52 | 0.97 | 0.96 | 63.50 | 610.32 | 1.14 | | |
| 170.50 | 6.50 | 0.95 | 0.94 | 73.50 | 572.96 | 1.12 | | |
| 180.50 | 6.49 | 0.94 | 0.93 | 83.50 | 547.94 | 1.11 | | |
| 190.50 | 6.48 | 0.93 | 0.92 | 93.50 | 531.03 | 1.10 | | |
| 200.50 | 6.48 | 0.92 | 0.92 | 103.50 | 519.73 | 1.09 | | |
| 210.50 | 6.46 | 0.91 | 0.90 | 113.50 | 512.47 | 1.07 | | |
| 220.50 | 6.47 | 0.92 | 0.91 | 123.50 | 508.20 | 1.09 | | |
| 232.30 | 6.46 | 0.91 | 0.90 | 135.30 | 506.06 | 1.07 | | |
| 240.00 | 6.47 | 0.92 | 0.91 | 143.00 | 505.99 | 1.09 | | |
| 249.10 | 6.45 | 0.90 | 0.89 | 152.10 | 506.98 | 1.06 | | |
| 261.50 | 6.44 | 0.89 | 0.88 | 164.50 | 509.86 | 1.05 | | |
| 269.60 | 6.42 | 0.87 | 0.86 | 172.60 | 512.52 | 1.03 | | |
| 281.70 | 6.44 | 0.89 | 0.88 | 184.70 | 517.43 | 1.05 | | |
| 289.35 | 6.42 | 0.87 | 0.86 | 192.35 | 521.03 | 1.03 | | |

023883

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti | ADJUSTED TIME min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 302.15 | 6.42 | 0.87 | 0.86 | 205.15 | 527.76 | 1.03 | | |
| 309.33 | 6.40 | 0.85 | 0.84 | 212.33 | 531.88 | 1.00 | | |
| 321.65 | 6.35 | 0.80 | 0.79 | 4.65 | 2382.69 | 1.24 | | |
| 333.00 | 6.32 | 0.77 | 0.76 | 16.00 | 1648.66 | 1.19 | | |
| 341.33 | 6.31 | 0.76 | 0.75 | 24.33 | 1466.01 | 1.18 | | |
| 351.82 | 6.28 | 0.73 | 0.72 | 34.82 | 1333.76 | 1.13 | | |
| 359.50 | 6.27 | 0.72 | 0.71 | 42.50 | 1269.65 | 1.12 | | |
| 371.77 | 6.25 | 0.70 | 0.70 | 54.77 | 1197.95 | 1.09 | | |
| 379.18 | 6.25 | 0.70 | 0.70 | 62.18 | 1166.33 | 1.09 | | |
| 391.65 | 6.22 | 0.67 | 0.67 | 74.65 | 1125.96 | 1.04 | | |
| 400.12 | 6.20 | 0.65 | 0.65 | 83.12 | 1105.17 | 1.01 | | |
| 411.43 | 6.18 | 0.63 | 0.63 | 94.43 | 1083.46 | 0.98 | | |
| 419.50 | 6.17 | 0.62 | 0.62 | 102.50 | 1071.27 | 0.96 | | |
| 431.90 | 6.15 | 0.60 | 0.60 | 1.90 | 556.15 | 0.93 | 1.90 | 227.32 |
| 436.50 | 6.15 | 0.60 | 0.60 | 6.50 | 161.90 | 0.93 | 6.50 | 67.15 |
| 441.92 | 6.12 | 0.57 | 0.57 | 11.92 | 87.91 | 0.89 | 11.92 | 37.07 |
| 448.50 | 6.08 | 0.53 | 0.53 | 18.50 | 56.39 | 0.82 | 18.50 | 24.24 |
| 452.50 | 6.05 | 0.50 | 0.50 | 22.50 | 46.26 | 0.78 | 22.50 | 20.11 |
| 456.00 | 6.02 | 0.47 | 0.47 | 26.00 | 39.96 | 0.73 | 26.00 | 17.54 |
| 461.50 | 5.99 | 0.44 | 0.43 | 31.50 | 32.90 | 0.68 | 31.50 | 14.65 |
| 467.00 | 5.95 | 0.40 | 0.40 | 37.00 | 27.95 | 0.62 | 37.00 | 12.62 |
| 472.00 | 5.93 | 0.38 | 0.38 | 42.00 | 24.59 | 0.59 | 42.00 | 11.24 |
| 477.00 | 5.90 | 0.35 | 0.35 | 47.00 | 21.95 | 0.54 | 47.00 | 10.15 |
| 482.50 | 5.88 | 0.33 | 0.33 | 52.50 | 19.63 | 0.51 | 52.50 | 9.19 |
| 490.00 | 5.85 | 0.30 | 0.30 | 60.00 | 17.16 | 0.47 | 60.00 | 8.17 |
| 500.00 | 5.82 | 0.27 | 0.27 | 70.00 | 14.70 | 0.42 | 70.00 | 7.14 |
| 510.00 | 5.80 | 0.25 | 0.24 | 80.00 | 12.87 | 0.38 | 80.00 | 6.38 |
| 520.00 | 5.76 | 0.21 | 0.20 | 90.00 | 11.45 | 0.32 | 90.00 | 5.78 |
| 530.00 | 5.72 | 0.17 | 0.17 | 100.00 | 10.33 | 0.27 | 100.00 | 5.30 |
| 540.00 | 5.71 | 0.16 | 0.16 | 110.00 | 9.41 | 0.25 | 110.00 | 4.91 |
| 550.00 | 5.70 | 0.15 | 0.14 | 120.00 | 8.65 | 0.23 | 120.00 | 4.58 |
| 560.00 | 5.68 | 0.13 | 0.13 | 130.00 | 8.01 | 0.20 | 130.00 | 4.31 |
| 590.00 | 5.65 | 0.10 | 0.10 | 160.00 | 6.59 | 0.16 | 160.00 | 3.69 |
| 620.00 | 5.61 | 0.06 | 0.06 | 190.00 | 5.63 | 0.09 | 190.00 | 3.26 |
| 650.00 | 5.59 | 0.04 | 0.04 | 220.00 | 4.94 | 0.06 | 220.00 | 2.95 |
| 680.00 | 5.58 | 0.03 | 0.03 | 250.00 | 4.43 | 0.05 | 250.00 | 2.72 |
| 710.00 | 5.58 | 0.03 | 0.03 | 280.00 | 4.03 | 0.05 | 280.00 | 2.54 |
| 740.00 | 5.57 | 0.02 | 0.02 | 310.00 | 3.71 | 0.03 | 310.00 | 2.39 |
| 770.00 | 5.56 | 0.01 | 0.01 | 340.00 | 3.45 | 0.02 | 340.00 | 2.26 |

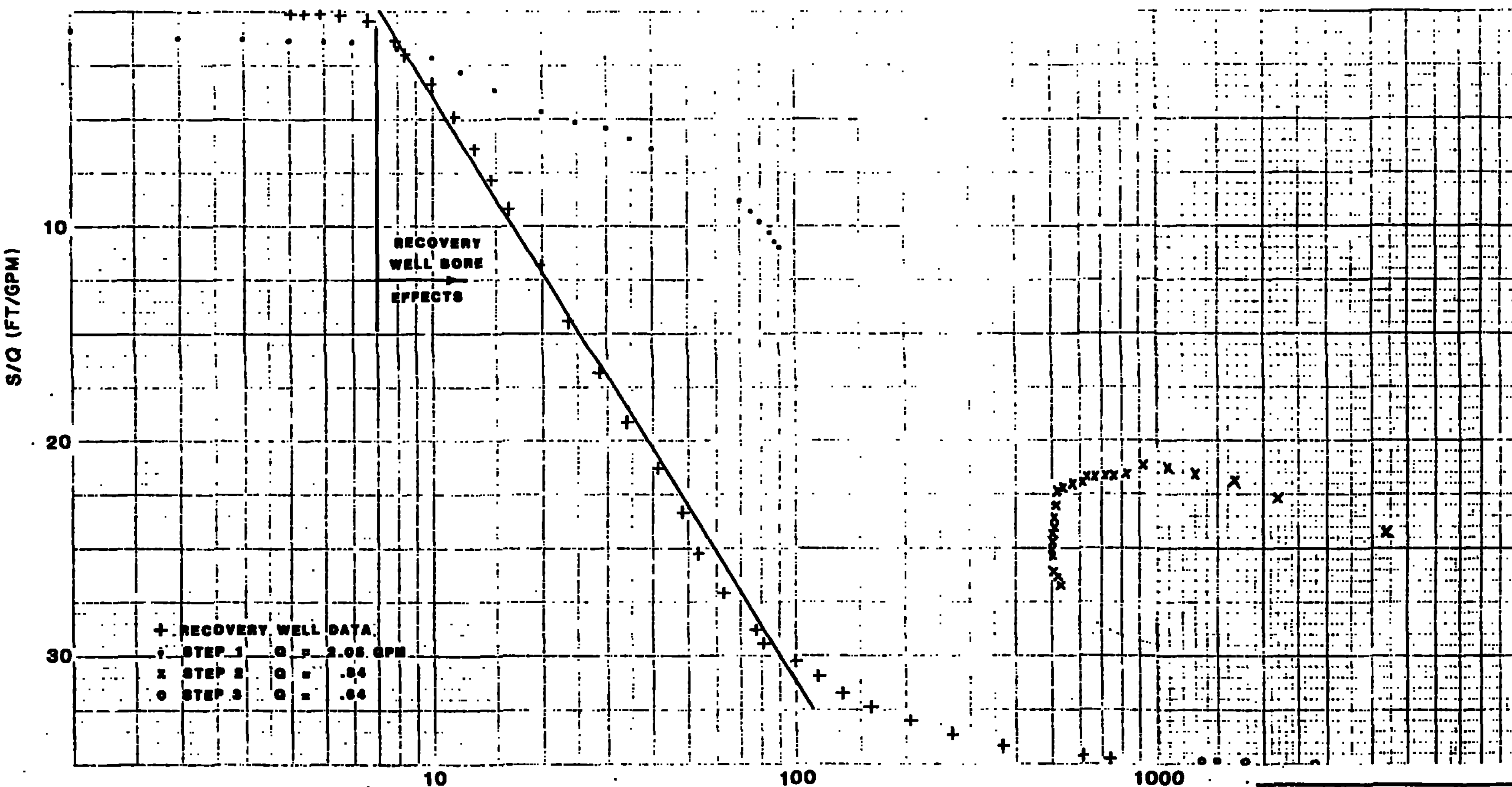
STEP DRAWDOWN TEST - WELL ERT 10

OBSERVATION WELL - REI-10-4

Saturated Thickness 42.54 feet

static water level 5.46 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0.00 | 5.46 | 0.00 | 0.00 | | |
| 20.00 | 5.60 | 0.14 | 0.14 | | |
| 40.00 | 5.85 | 0.39 | 0.39 | | |
| 68.00 | 6.02 | 0.56 | 0.56 | | |
| 91.00 | 6.11 | 0.65 | 0.65 | | |
| 125.00 | 6.04 | 0.58 | 0.58 | | |
| 150.00 | 5.97 | 0.51 | 0.51 | | |
| 181.00 | 5.95 | 0.49 | 0.49 | | |
| 214.00 | 5.95 | 0.49 | 0.49 | | |
| 246.00 | 5.94 | 0.48 | 0.48 | | |
| 273.00 | 5.93 | 0.47 | 0.47 | | |
| 308.00 | 5.93 | 0.47 | 0.47 | | |
| 344.00 | 5.88 | 0.42 | 0.42 | | |
| 365.00 | 5.88 | 0.42 | 0.42 | | |
| 392.00 | 5.84 | 0.38 | 0.38 | | |
| 420.00 | 5.82 | 0.36 | 0.36 | | |
| 430.00 | 5.82 | 0.36 | 0.36 | | |
| 431.00 | 5.82 | 0.36 | 0.36 | 1.00 | 431.00 |
| 435.00 | 5.81 | 0.35 | 0.35 | 5.00 | 87.00 |
| 440.00 | 5.80 | 0.34 | 0.34 | 10.00 | 44.00 |
| 448.00 | 5.78 | 0.32 | 0.32 | 18.00 | 24.89 |
| 453.00 | 5.77 | 0.31 | 0.31 | 23.00 | 19.70 |
| 458.00 | 5.75 | 0.29 | 0.29 | 28.00 | 16.36 |
| 475.00 | 5.70 | 0.24 | 0.24 | 45.00 | 10.56 |
| 490.00 | 5.66 | 0.20 | 0.20 | 60.00 | 8.17 |
| 505.00 | 5.63 | 0.17 | 0.17 | 75.00 | 6.73 |
| 520.00 | 5.60 | 0.14 | 0.14 | 90.00 | 5.78 |
| 535.00 | 5.58 | 0.12 | 0.12 | 105.00 | 5.10 |
| 550.00 | 5.57 | 0.11 | 0.11 | 120.00 | 4.58 |
| 565.00 | 5.55 | 0.09 | 0.09 | 135.00 | 4.19 |
| 595.00 | 5.55 | 0.09 | 0.09 | 165.00 | 3.61 |
| 625.00 | 5.51 | 0.05 | 0.05 | 195.00 | 3.21 |
| 655.00 | 5.50 | 0.04 | 0.04 | 225.00 | 2.91 |
| 685.00 | 5.50 | 0.04 | 0.04 | 255.00 | 2.69 |
| 715.00 | 5.49 | 0.03 | 0.03 | 285.00 | 2.51 |
| 745.00 | 5.48 | 0.02 | 0.02 | 315.00 | 2.37 |
| 775.00 | 5.47 | 0.01 | 0.01 | 345.00 | 2.25 |




B-244

FRENCH LIMITED PROJECT
CROSBY, TEXAS

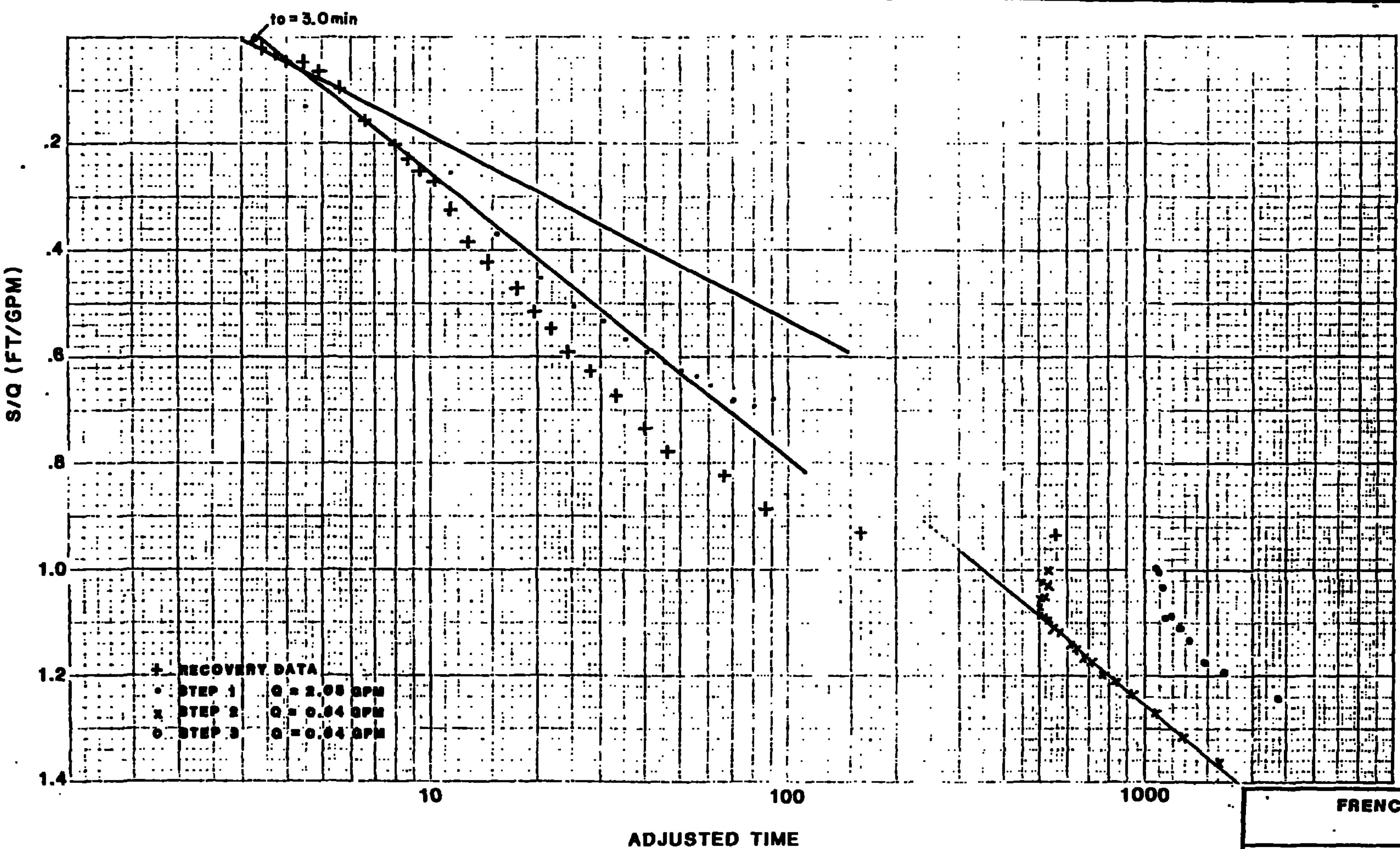
FIGURE A2-6
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL: ERT-10
OBSERVATION WELL: ERT-10
DATE(S): AUG. 15, 1988

| PROJECT No. 26 | DATE 9/12 | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

023885




**OBSERVATION WELL ERT-9**
**RECOVERY ANALYSIS**

$$T = \frac{264}{\Delta(S/Q)} \text{ gpd/ft}$$

$$T = \frac{264}{0.35} = 754 \text{ gpd/ft}$$

$$S = \frac{T\,(to)}{4790\,r^2}$$

$$S = \frac{759(3.0)}{4790(9.05)^2}$$

$$S = .0058$$

B-245

**FRENCH LIMITED PROJECT**
CROSBY, TEXAS

**FIGURE A2-7**
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

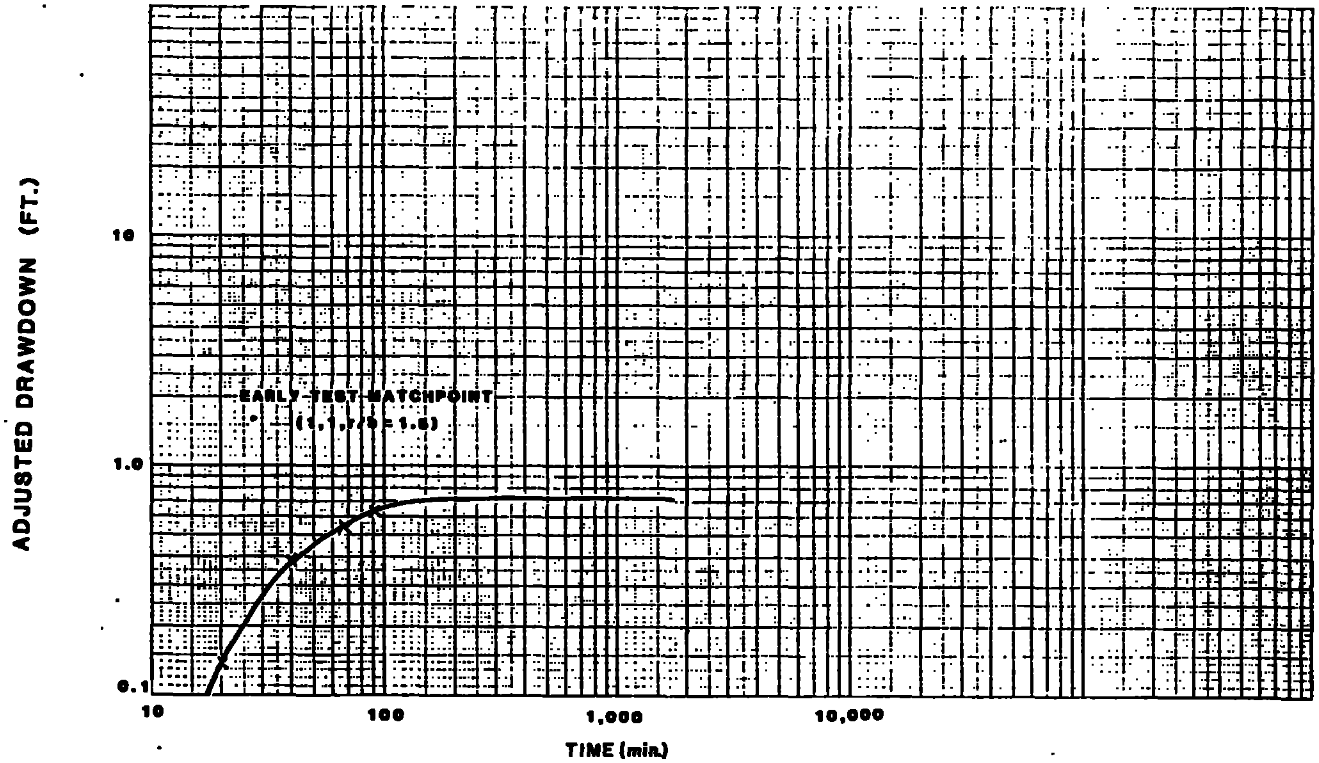
PUMPED WELL: ERT-10
OBSERVATION WELL: ERT-9
DATE(S): AUG. 15, 1988

| PROJECT No. 26 | DATE | REVISION |
| --- | --- | --- |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

023836

023887




**OBSERVATION WELL REI-IO-4 ANALYSIS**

$$T = \frac{1.0\ Q}{4\pi\ S} = \frac{2.05 \times 1440\ \text{min./day}}{4\pi(1.62)}$$

$T = 145$ gpd/ft $= .01346\ ft^2/min$

$$Se = \frac{4\ T\ t}{r^2} = \frac{4\ (.01346\ ft^2/min)\ (27\ min.)}{(44.6)^2}$$

$Se = .000785$

B-246

| FRENCH LIMITED PROJECT<br>CROSBY, TEXAS | | |
|---|---|---|
| **FIGURE A2-8**<br>BOULTON DELAYED YIELD ANALYSIS<br>PUMPED WELL: ERT-10<br>OBSERVATION WELL: REI-10-4<br>DATE(S): AUGUST 15, 1988 | | |
| PROJECT No. 26 | DATE 9/12 | REVISION |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

023898

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TESTS: August 8 and 9, 1988

PUMPED WELL: ERT-20

TOTAL DEPTH: 50 FEET

OBSERVATION WELLS: GW-08, radial distance 156.7 feet

CONTROL WELLS: ERT-21, REI-6-2, ERT-7 and ERT-7A

BACKGROUND AND DESCRIPTION OF TEST:

The test of well ERT-20 was included to provide information about aquifer characteristics in the vicinity of possible groundwater recovery wells south of the French Limited Lagoon. There were no preliminary aquifer test data upon which to base a pumping rate for the test. The personnel performing the test decided to attempt to pump the well at 10 gpm because at this rate there was a possibility that a response would occur in observation well GW-08 during an eight-hour test. An observation well response would be needed to determine a storage coefficient at this location and it was thought that pumping at a lower rate would not likely produce a response in the nearest well.

Lithologic and well completion logs and an illustration of the location of the pumped well, ERT-20 and the observation well, GW-8, precede the aquifer test data which follow.

Prior to pumping well ERT-20, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to .01 feet. The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder at the pumped well, the observation well and the control wells. The test was started and a flow measurement of ten gpm was obtained using the bucket and stop watch. The water level was drawn down to the pump intake after about 25 minutes and the test was terminated after 25.5 minutes of pumping. Only one flow measurement had been taken with a bucket and stop watch. The flow was visually observed to have declined to a trickle after 25 minutes. Recovery measurements were taken at the pumped well for about 3.75 hours following termination of pumping.

The test was re-run on August 9. Water level measurements were taken with an electronic sounder at the pumped well, the observation well and the control wells. The drawdown values for the pumped well were determined and corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions:

$$s' = s - s^2/2Ho$$

where: s' = adjusted drawdown
s = drawdown and
Ho = initial saturated thickness

The attached data sheet presents the measurements for the pumped well during the pump test and recovery period. The data sheets include the observed drawdowns and the corrected drawdowns.

During this test the water was pumped through a hose directly into the French Limited Lagoon some distance away. Flow measurements were taken using a bucket and stop watch by personnel monitoring the control wells; flow data were recorded on the control well monitoring forms. The valve in the discharge hose was set to maintain a constant rate of about 2.04 gpm for the first 75 minutes of the test. However, the flow increased to about 2.5 gpm after 85 minutes of pumping. It was assumed that the pumping rate changed after 78 minutes into the test although the change may have been more gradual than abrupt. The flow measurement after 115 minutes of pumping showed a rate of 2.67 gpm. Even though the generator powering the submersible pump was changed 99 minutes into the test, this was not thought to have contributed to the increase in the pumping rate because most of the rate increase occurred prior to changing generators.

At approximately 136.5 minutes into the test, the pump stopped unexpectedly. Water level recovery measurements were taken at the pumped well during the first two hours following termination of pumping. The pump was pulled following completion of the recovery measurements. A short in the electrical cable had caused the pump to stop. The cable was replaced. However, it was decided not to repeat the test because the pumping rate which could be sustained during the eight-hour test was not likely to have produced a response in the nearest observation well, GW-08, located about 157 feet from the pumped well. It was thought that there would be little value to repeating a single well test of longer duration at the site, and that the effort could be spent more productively at another location.

Following discussions with Ms. Kathleen O'Reiley of the Region VI U.S. EPA on site on August 11, it was agreed that a pump test of well ERT-22 would be more useful than conducting a longer term test on well ERT-20.

Water produced from the test was pumped into 55-gallon drums during the first test. The contents of the 55-gallon drums were emptied into the French Limited Lagoon following completion of the first test. During the second test, a discharge hose was run directly to the French Limited Lagoon.

Observation and control wells were monitored for water levels about every one-half hour during pumping but were not monitored during recovery. Field measurements for the observation and control wells are attached.

INTERPRETATION:

The control wells ERT-7, ERT-7a, ERT-21 and GW-8 showed no obvious response due to pumping well ERT-20. The water levels in all four wells declined from 0 to 0.04 feet during the test. These changes were obviously small and thought to follow a diurnal pattern similar to that observed for the control wells during the ERT-10 well test.

Based on the "u" parameter criterion, the semi-log techniques would be applicable to nearly the entire data range for the pumped well except that portion subject to well bore storage influences. The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2.1 and shown below:

tc = 0.6(16-1)/(2.05/5.05*) = 20.9 minutes

* drawdown at time tc = 20 min.

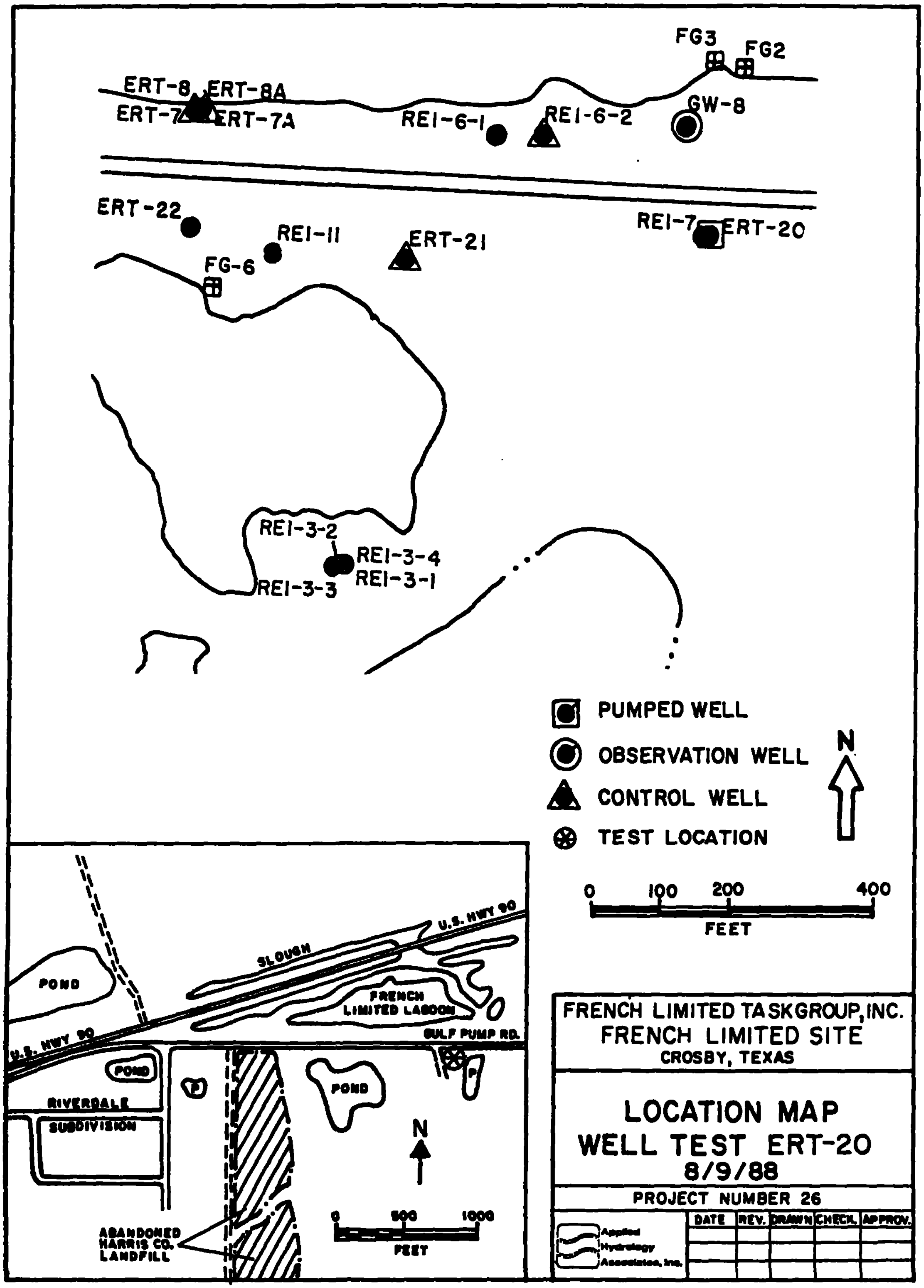
Drawdown and adjusted drawdown values are included in the attached data sheet. Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data.

The ratio of adjusted drawdown to the associated pumping rate for the production well ERT-20 was plotted against the log of adjusted time on the attached semi-log graph in Figure A2-9. The ratio of the adjusted residual drawdown (recovery) to the final pumping rate was also plotted against the log of dimensionless time on the same semi-log plots. Well bore effects had a significant influence for about the first 20 minutes of each constant rate pumping interval and on the first 20 minutes of the recovery data.

The transmissivity calculated from the valid portion of the recovery data on the semi-log plots was 695 gpd/ft. The transmissivity calculated from the valid portion of the initial drawdown data was 343 gpd/ft. The estimate from the recovery data is considered to be the more reliable estimate. Delayed yield effects were not observed but could have been masked by the variable pumping rate.

A storage coefficient could not be determined from the single well response data.

023891



FG3
FG2
ERT-8
ERT-8A
ERT-7
ERT-7A
REI-6-1
REI-6-2
GW-8
ERT-22
REI-11
ERT-21
REI-7
ERT-20
FG-6
REI-3-2
REI-3-4
REI-3-1
REI-3-3
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0
100
200
400
FEET
U.S. HWY 90
SLOUGH
POND
FRENCH LIMITED LAGOON
GULF PUMP RD.
RIVERDALE
SUBDIVISION
ABANDONED HARRIS CO. LANDFILL
0
500
1000
FEET
FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-20
8/9/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV.
DRAWN
CHECK.
APPROV.

**ERT** 02 3832

**A RESOURCE ENGINEERING COMPANY**



# BORING LOG AND CONSTRUCTION OF ERT- 20

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-20
Logged By: Steve Reahm
Approved By: Ram Patel
Drilled By: Gulf Coast Drilling Driller's Name: Jim Turner

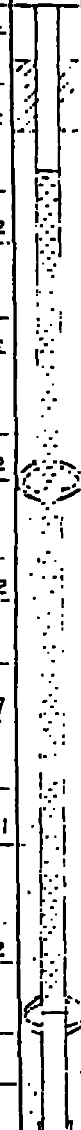
**DRILLING AND SAMPLING INFORMATION**

Date Started: 12-29-87 Date Completed: 12-30-87
Method: Mud Rotary Total Depth: 47.0 Feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch ϕ Length: 35.0 Feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch ϕ Length: 7.0 Feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | BLOW COUNTS/ PUSH SAMPLE | PENETROMETER RECOVERY READING | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown clayey Silt with roots (ML) | – | ST | – | P.S | – | 0.2 | | |
| | (3.5') | | | | | | | | |
| 5 | Soft dark gray Clay with occasional gravel & roots (CH) | – | ST | – | P.S | – | 0.2 | | |
| | – fine to medium Sand seams & pockets from 9.0' | | | | | | | | |
| | (9.0') | | | | | | | | |
| 10 | Medium dense to dense gray fine to medium clayey Sand (SC) | – | ST | – | P.S | – | 3.2 | | |
| | (14.0') | | | | | | | | |
| 15 | Dense gray fine to medium Sand, slightly silty. (SP) (Seeable/wet) | – | SS | – | 7/14/14 | – | 3.2 | | |
| 20 | – chemical odor at 20.0' | – | SS | – | 10/14/20 | – | 4.2 | | |
| 25 | – medium to coarse sand with gravel from 24.0' | – | SS | – | 11/17/11 | – | 8.2 | | |
| | (27.0') | | | | | | | | |
| 30 | Stiff dark red and brown Clay (CH) | – | ST | – | P.S. | – | 0.7 | | |
| | (33.0') | | | | | | | | |
| 35 | Dark olive gray clayey Silt (SC) with numerous sand partings and pockets | – | ST | – | P.S. | – | 0.1 | | |
| | (38.0') | | | | | | | | |
| 40 | Dark Gray and tan Silty fine Sand (SM) with clay pockets & partings | J-1 | SS | 40.0 | 30/50-6 | – | 0.2 | | |
| | (42.0') | | | | | | | | |
| 45 | Very stiff dark red & gray Clay (CH) with slickensides (Beaumont formation) | J-2 | ST | 45.0 | P.S | – | – | | |
| | (47.0') | | | | | | | | |
| 50 | | | | | | | | | |



**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

# ERT 02 18.33

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

## BORING LOG AND CONSTRUCTION OF ERT-21

Client: ARCO Chemical Company
Project Name: French Site Limited
Project Location: Crosby, Texas
Job No.: 275-23-01    Boring No.: ERT-21
Logged By: Steve Preston
Approved By: Raal Patel
Drilled By: Gulf Coast Drilling Co.    Driller's Name: Jim Turner

**DRILLING AND SAMPLING INFORMATION**

Date Started: 12-23-87    Date Completed: 12-23-87
Method: Mud Rotary    Total Depth: 47.0 feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch Ø    Length: 35.0 feet
Slot Size: 0.010 inch    Type: PVC
Casing Dia.: 4-inch Ø    Length: 7.0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (In feet) | POCKET PENETROMETER (Tons/Ft.²) | BLOW COUNTS | % RECOVERY | HNU VALUE (In units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown to black silty to clayey fine sand (SC) | (1.5') | - | ST | 0.0 1.5 | - | - | | 3.4 | | |
| | Light brown silty fine to medium sand. (SM-SP) | (3.0') | | | | | | | | | |
| 5 | Dark tan and brown clayey fine to medium sand. (SC) | (8.0') | - | ST | 3.0 5.0 | - | - | | 4.0 | | |
| 10 | Medium dense to dense light gray fine to medium sand, slightly silty and wet. (SP) | | - | ST | 8.0 10.0 | - | - | | 5.4 | | |
| 15 | - Dense with coarse grains from 15.0' | | C-1 | SS | 13.5 15.0 | - | 12/15/16 | | 4.4 | | |
| 20 | - Medium dense with coarse grains from 20.0' | | - | SS | 18.5 20.0 | - | 10/11/15 | | 3.[illegible] 6.4 | | |
| 25 | - 1-inch thick medium to coarse gravel layer at 24.5' | (24.5') | - | SS | 23.5 25.0 | 3.5 fast 6 | 2/6/14 | | 3.9 | | |
| | Stiff to very stiff, light gray clay with silt partings and pockets. (CH) | (27.0') | | | | | | | | | |
| 30 | Dense olive gray clayey silt. (ML) | | C-2 | ST | 28.0 30.0 | 3.0 | - | | 3.4 | | |
| 35 | | (38.0') | - | SS | 33.5 35.0 | - | 17/20/24 | | 4.4 | | |
| 40 | Dense light gray and dark tan clayey sand. (SC) | (44.0') | - | SS | 38.0 40.0 | - | 16/27/26 | | 14.4 | | |
| 45 | Very stiff dark red and olive gray clay. (CH) (Beaumont clay) | (47.0') | C-3 | ST | 43.0 45.0 | 3.5 | - | | 3.4 | | |
| 50 | | | | | | | | | | | |
| 55 | | | | | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON    CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE    RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS    DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS    MD - MUD DRILLING

02 ?:34

**ERT.**
A RESOURCE ENGINEERING COMPANY



## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-7

Client : French LTD.
Project Name : French LTD.
Project Location : Crosby, Texas
Job Number : 275-21 Boring No : ERT-7
Logged By : D. Morgan
Approved By : G. Spradley
Drilled By : Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started : 9/28/87 Date Completed : 9/28/87
Method : MR Total Depth : 48'

WELL COMPLETION INFORMATION
Screen Dia : 4" Length : 28.0'
Slot Size : .010 Type : PVC
Casing Dia : 4" Length : 17.7'

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION : | | | | | | | | |
| | Fill, roadbase, gravel, sand, silt | | | | | | | | |
| | Silty Sand, tan to brown/ gray, fine to medium grained some black sludge material | 1 | ST | 80 | - | | | | |
| 5 | | 2 | SS | 50 | 0.4 | | | | |
| | | 3 | SS | 50 | 0.2 | | | | |
| | | 4 | SS | 45 | 0.2 | | | | |
| 10 | | 5 | SS | 25 | 0.2 | | | | |
| | | 6 | SS | 50 | 0.6 | | | | |
| 15 | | 7 | SS | 50 | 0.8 | | | | |
| | Sand, fine to medium grained, gray, strong odor | 8 | SS | 13 | 0.4 | | | | |
| | | 9 | SS | NR | | | | | |
| 20 | | 10 | SS | 17 | - | | | | |
| | | 11 | SS | 45 | - | | | | |
| 25 | | 12 | SS | 25 | - | | | | |
| | | 13 | SS | 25 | - | | | | |
| | Silty Clay, gray with some red/brown mottles, stiff, with some fine grained sand seams some odor | 14 | SS | 50 | - | | | | |
| 30 | | 15 | ST | 75 | - | | | | |
| | | 16 | ST | 50 | - | | | | |
| 35 | Clayey Silt, light gray, soft, saturated some odor | 17 | ST | 75 | - | | | | |
| | | 19 | ST | NR | | | | | |
| 40 | | 20 | ST | 75 | - | | | | |
| | | 21 | SS | 50 | - | | | | |
| | | 22 | SS | 65 | - | | | | |
| 45 | | 23 | ST | 50 | - | | | | |
| | Silty Clay, light gray, stiff, some tan mottles, no odor | 24 | ST | 84 | - | | | | |
| 50 | BORING TERMINATED AT 48.0' | | | | | | | | |
| 55 | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE

BORING METHOD
HSA - HOLLOW STEM AUGER
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

023895

Sheet 1 of 1

**ERT**

A RESOURCE ENGINEERING COMPANY

# BORING LOG AND CONSTRUCTION OF ERT-7A

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-7A
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

DRILLING AND SAMPLING INFORMATION
Date Started: 11-17-87 Date Completed: 11-17-87
Method: Mud Rotary Total Depth: 20.5 feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch Ø Length: 15.0 feet
Slot Size: 0.010 inch Type: PVC
Casing Dia.: 4-inch Length: 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.5') | | | | | | | | | |
| | Gray medium to fine silty sand (25.0') | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

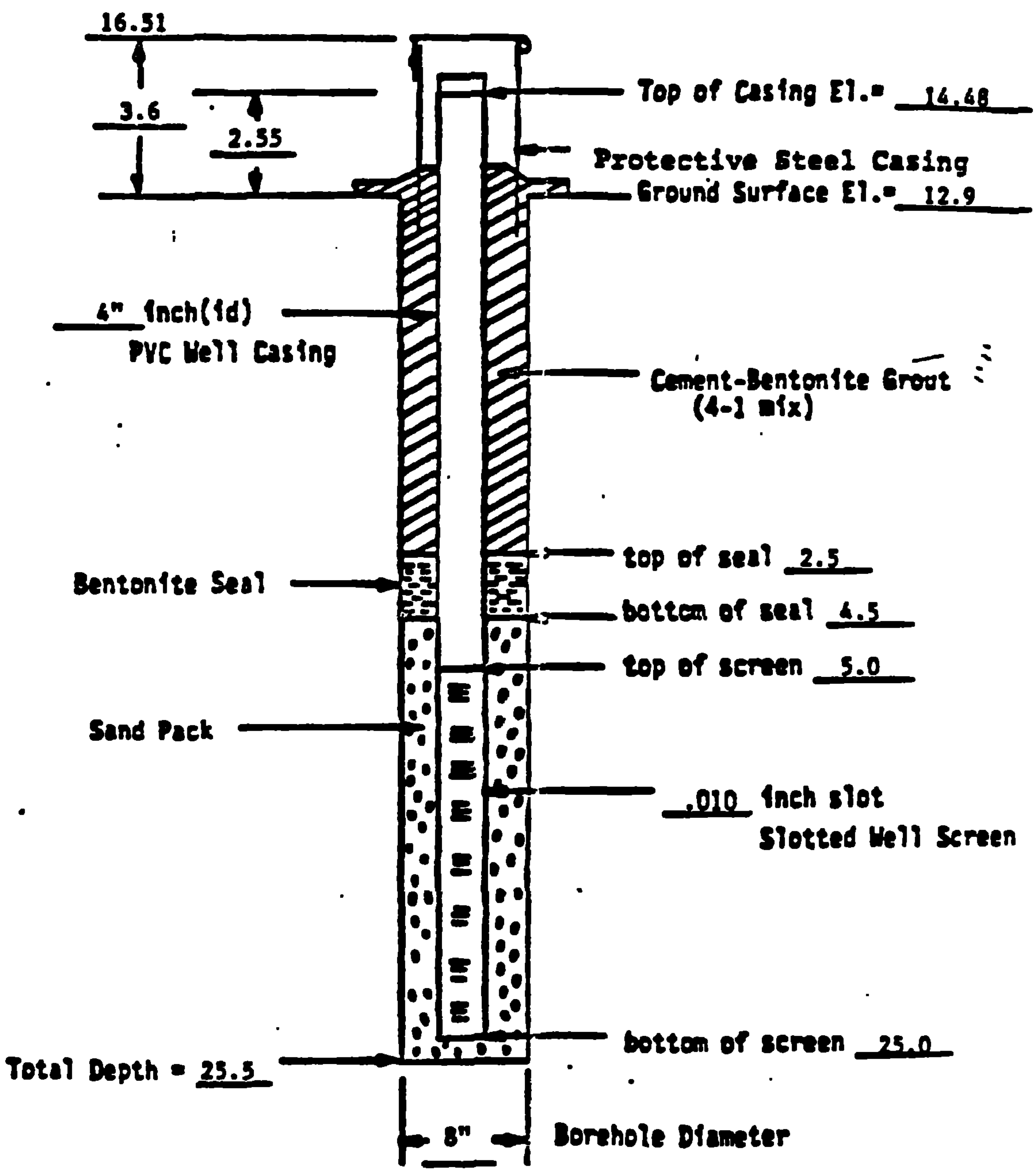
BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

Details of Monitor Well Construction

Project Name: FRENCH LIMITED SITE    Boring Number: REI:6-2

Project Number: 275-02    Date Installed: 3-7-84

Water Level Measurement: 6.65 (El. = 8.83 on 4-10-84)




REI

PUMPED WELL: ERT-20

CONTROL WELL WATER LEVEL FLUCTUATIONS

| HOUR | min | REI-6-2 | MEAN-DEV REI-6-2 7.20 | ERT-7 | MEAN-DEV ERT-7 4.85 | ERT-7A | MEAN-DEV ERT-7A 5.43 | ERT-21 | MEAN-D ERT-21 4.79 |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 35 | 7.2 | 0.00 | | | | | | |
| 8 | 12 | 7.2 | 0.00 | | | | | | |
| 8 | 49 | 7.2 | 0.00 | | | | | | |
| 9 | 55 | 7.21 | -0.01 | | | | | | |
| 10 | 34 | 7.21 | -0.01 | | | | | | |
| 7 | 41 | | | 4.83 | 0.02 | | | | |
| 8 | 16 | | | 4.85 | -0.00 | | | | |
| 8 | 53 | | | 4.85 | -0.00 | | | | |
| 9 | 38 | | | 4.85 | -0.00 | | | | |
| 10 | 28 | | | 4.85 | -0.00 | | | | |
| 7 | 40 | | | | | 5.42 | 0.01 | | |
| 8 | 15 | | | | | 5.43 | 0.00 | | |
| 8 | 52 | | | | | 5.44 | -0.01 | | |
| 9 | 37 | | | | | 5.45 | -0.02 | | |
| 10 | 31 | | | | | 5.43 | 0.00 | | |
| 7 | 54 | | | | | | | 4.79 | 0 |
| 8 | 35 | | | | | | | 4.79 | 0 |
| 10 | 1 | | | | | | | 4.79 | 0 |

STEP DRAWDOWN TEST - WELL ERT-20

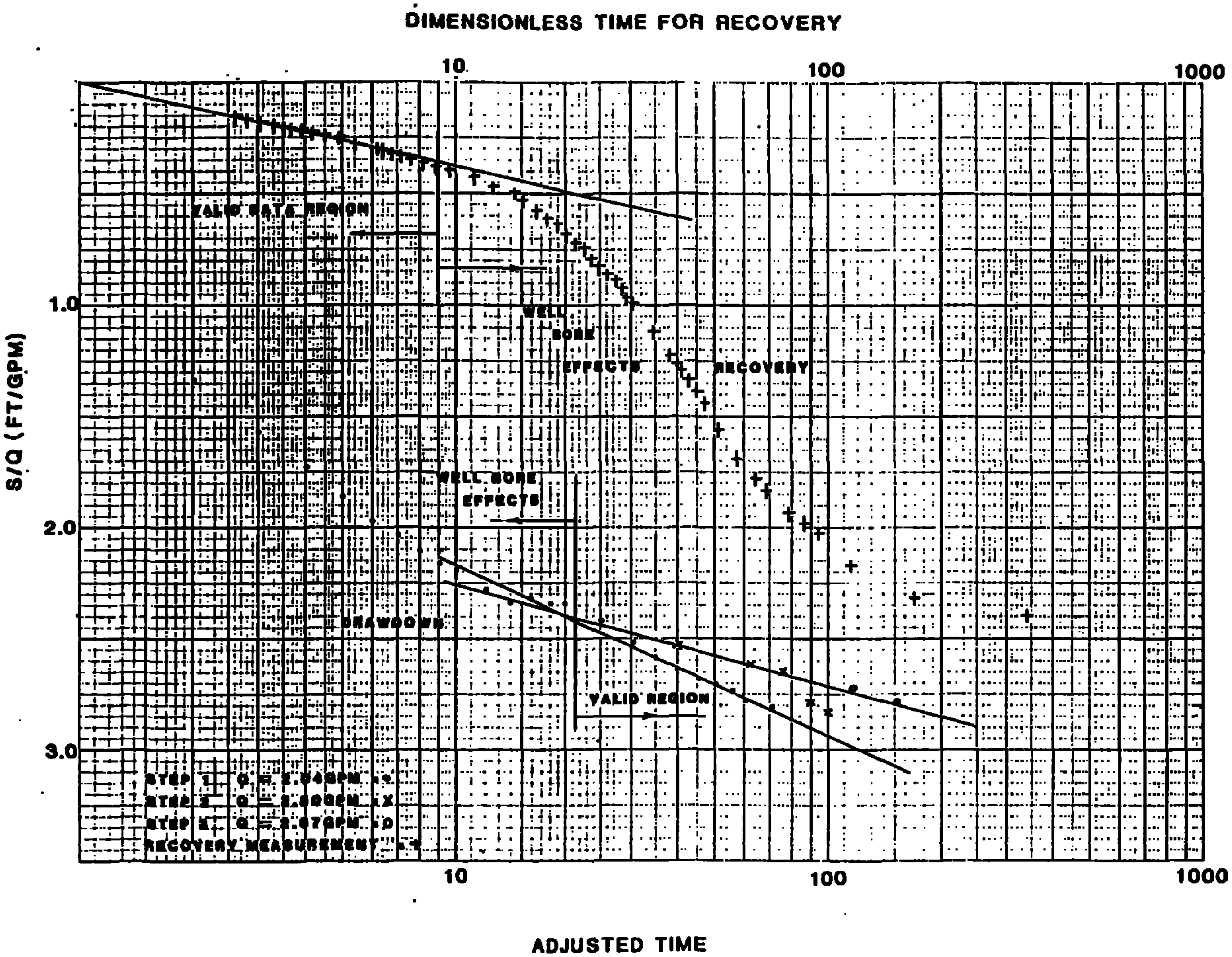
Saturated Thickness 44.24 feet

static water level 5.76 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-tn | adjusted time | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 5.76 | 0.00 | 0.00 | | 0.00 | 0.00 | | |
| 0.50 | 7.16 | 1.40 | 1.38 | | 0.50 | 0.68 | | |
| 1.00 | 7.80 | 2.04 | 1.99 | | 1.00 | 0.98 | | |
| 2.00 | 8.56 | 2.80 | 2.71 | | 2.00 | 1.33 | | |
| 3.00 | 9.07 | 3.31 | 3.19 | | 3.00 | 1.56 | | |
| 4.00 | 9.42 | 3.66 | 3.51 | | 4.00 | 1.72 | | |
| 5.00 | 9.73 | 3.97 | 3.79 | | 5.00 | 1.86 | | |
| 6.00 | 9.96 | 4.20 | 4.00 | | 6.00 | 1.96 | | |
| 7.00 | 10.13 | 4.37 | 4.15 | | 7.00 | 2.04 | | |
| 8.00 | 10.28 | 4.52 | 4.29 | | 8.00 | 2.10 | | |
| 9.00 | 10.39 | 4.63 | 4.39 | | 9.00 | 2.15 | | |
| 10.00 | 10.48 | 4.72 | 4.47 | | 10.00 | 2.19 | | |
| 12.00 | 10.67 | 4.91 | 4.64 | | 12.00 | 2.27 | | |
| 14.00 | 10.80 | 5.04 | 4.75 | | 14.00 | 2.33 | | |
| 16.00 | 10.76 | 5.00 | 4.72 | | 16.00 | 2.31 | | |
| 18.00 | 10.81 | 5.05 | 4.76 | | 18.00 | 2.33 | | |
| 20.00 | 10.81 | 5.05 | 4.76 | | 20.00 | 2.33 | | |
| 25.00 | 11.00 | 5.24 | 4.93 | | 25.00 | 2.42 | | |
| 30.00 | 11.22 | 5.46 | 5.12 | | 30.00 | 2.51 | | |
| 35.00 | 11.40 | 5.64 | 5.28 | | 35.00 | 2.59 | | |
| 40.00 | 11.51 | 5.75 | 5.38 | | 40.00 | 2.64 | | |
| 45.00 | 11.61 | 5.85 | 5.46 | | 45.00 | 2.68 | | |
| 50.00 | 11.67 | 5.91 | 5.52 | | 50.00 | 2.70 | | |
| 55.00 | 11.75 | 5.99 | 5.58 | | 55.00 | 2.74 | | |
| 60.00 | 11.85 | 6.09 | 5.67 | | 60.00 | 2.78 | | |
| 70.00 | 11.91 | 6.15 | 5.72 | | 70.00 | 2.81 | | |
| 80.00 | 12.61 | 6.85 | 6.32 | 2.00 | 40.58 | 2.53 | | |
| 90.00 | 12.85 | 7.09 | 6.52 | 12.00 | 62.12 | 2.61 | | |
| 100.00 | 12.95 | 7.19 | 6.61 | 22.00 | 75.68 | 2.64 | | |
| 111.00 | 13.40 | 7.64 | 6.98 | 33.00 | 88.80 | 2.79 | | |
| 120.00 | 13.53 | 7.77 | 7.09 | 42.00 | 98.92 | 2.84 | | |
| 150.00 | 13.77 | 8.01 | 7.28 | 25.00 | 117.93 | 2.73 | | |
| 180.00 | 13.96 | 8.20 | 7.44 | 55.00 | 151.35 | 2.79 | | |
| 197.00 | 12.70 | 6.94 | 6.40 | 0.50 | 338.80 | 2.40 | 0.25 | 788.00 |
| 197.50 | 12.45 | 6.69 | 6.18 | 1.00 | 169.93 | 2.32 | 0.75 | 263.33 |
| 198.00 | 12.00 | 6.24 | 5.80 | 1.50 | 113.64 | 2.17 | 1.25 | 158.40 |
| 198.33 | 11.55 | 5.79 | 5.41 | 1.83 | 93.18 | 2.03 | 1.58 | 125.29 |
| 198.50 | 11.40 | 5.64 | 5.28 | 2.00 | 85.49 | 1.98 | 1.75 | 113.43 |
| 198.67 | 11.25 | 5.49 | 5.15 | 2.17 | 78.98 | 1.93 | 1.92 | 103.63 |
| 199.00 | 10.95 | 5.19 | 4.89 | 2.50 | 68.60 | 1.83 | 2.25 | 88.44 |
| 199.17 | 10.79 | 5.03 | 4.74 | 2.67 | 64.37 | 1.78 | 2.42 | 82.40 |
| 199.50 | 10.50 | 4.74 | 4.49 | 3.00 | 57.34 | 1.68 | 2.75 | 72.55 |
| 199.83 | 10.12 | 4.36 | 4.15 | 3.33 | 51.72 | 1.55 | 3.08 | 64.82 |
| 200.17 | 9.80 | 4.04 | 3.86 | 3.67 | 47.10 | 1.44 | 3.42 | 58.58 |
| 200.33 | 9.65 | 3.89 | 3.72 | 3.83 | 45.11 | 1.39 | 3.58 | 55.91 |

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-tn | adjusted time | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 200.50 | 9.51 | 3.75 | 3.59 | 4.00 | 43.27 | 1.34 | 3.75 | 53.47 |
| 200.67 | 9.36 | 3.60 | 3.45 | 4.17 | 41.58 | 1.29 | 3.92 | 51.23 |
| 200.83 | 9.27 | 3.51 | 3.37 | 4.33 | 40.02 | 1.26 | 4.08 | 49.19 |
| 201.00 | 9.14 | 3.38 | 3.25 | 4.50 | 38.58 | 1.22 | 4.25 | 47.29 |
| 201.50 | 8.82 | 3.06 | 2.95 | 5.00 | 34.83 | 1.11 | 4.75 | 42.42 |
| 202.20 | 8.50 | 2.74 | 2.66 | 5.70 | 30.68 | 0.99 | 5.45 | 37.10 |
| 202.40 | 8.40 | 2.64 | 2.56 | 5.90 | 29.67 | 0.96 | 5.65 | 35.82 |
| 202.63 | 8.30 | 2.54 | 2.47 | 6.13 | 28.59 | 0.92 | 5.88 | 34.44 |
| 202.92 | 8.20 | 2.44 | 2.37 | 6.42 | 27.37 | 0.89 | 6.17 | 32.90 |
| 203.20 | 8.10 | 2.34 | 2.28 | 6.70 | 26.25 | 0.85 | 6.45 | 31.50 |
| 203.53 | 8.00 | 2.24 | 2.18 | 7.03 | 25.06 | 0.82 | 6.78 | 30.01 |
| 203.88 | 7.90 | 2.14 | 2.09 | 7.38 | 23.92 | 0.78 | 7.13 | 28.58 |
| 204.30 | 7.80 | 2.04 | 1.99 | 7.80 | 22.70 | 0.75 | 7.55 | 27.06 |
| 204.75 | 7.70 | 1.94 | 1.90 | 8.25 | 21.52 | 0.71 | 8.00 | 25.59 |
| 205.30 | 7.60 | 1.84 | 1.80 | 8.80 | 20.24 | 0.67 | 8.55 | 24.01 |
| 205.87 | 7.50 | 1.74 | 1.71 | 9.37 | 19.08 | 0.64 | 9.12 | 22.58 |
| 206.53 | 7.40 | 1.64 | 1.61 | 10.03 | 17.88 | 0.60 | 9.78 | 21.11 |
| 207.42 | 7.30 | 1.54 | 1.51 | 10.92 | 16.52 | 0.57 | 10.67 | 19.44 |
| 208.45 | 7.20 | 1.44 | 1.42 | 11.95 | 15.18 | 0.53 | 11.70 | 17.82 |
| 209.00 | 7.10 | 1.34 | 1.32 | 12.50 | 14.56 | 0.49 | 12.25 | 17.06 |
| 211.00 | 7.00 | 1.24 | 1.22 | 14.50 | 12.69 | 0.46 | 14.25 | 14.81 |
| 213.00 | 6.90 | 1.14 | 1.13 | 16.50 | 11.28 | 0.42 | 16.25 | 13.11 |
| 216.00 | 6.82 | 1.06 | 1.05 | 19.50 | 9.70 | 0.39 | 19.25 | 11.22 |
| 218.00 | 6.77 | 1.01 | 1.00 | 21.50 | 8.90 | 0.37 | 21.25 | 10.26 |
| 220.00 | 6.73 | 0.97 | 0.96 | 23.50 | 8.23 | 0.36 | 23.25 | 9.46 |
| 222.00 | 6.68 | 0.92 | 0.91 | 25.50 | 7.67 | 0.34 | 25.25 | 8.79 |
| 224.00 | 6.64 | 0.88 | 0.87 | 27.50 | 7.18 | 0.33 | 27.25 | 8.22 |
| 226.00 | 6.61 | 0.85 | 0.84 | 29.50 | 6.77 | 0.32 | 29.25 | 7.73 |
| 228.00 | 6.57 | 0.81 | 0.80 | 31.50 | 6.40 | 0.30 | 31.25 | 7.30 |
| 230.00 | 6.55 | 0.79 | 0.78 | 33.50 | 6.08 | 0.29 | 33.25 | 6.92 |
| 235.00 | 6.47 | 0.71 | 0.70 | 38.50 | 5.43 | 0.26 | 38.25 | 6.14 |
| 240.00 | 6.42 | 0.66 | 0.66 | 43.50 | 4.92 | 0.25 | 43.25 | 5.55 |
| 245.00 | 6.37 | 0.61 | 0.61 | 48.50 | 4.52 | 0.23 | 48.25 | 5.08 |
| 250.00 | 6.36 | 0.60 | 0.60 | 53.50 | 4.19 | 0.22 | 53.25 | 4.69 |
| 255.00 | 6.31 | 0.55 | 0.55 | 58.50 | 3.92 | 0.20 | 58.25 | 4.38 |
| 260.00 | 6.29 | 0.53 | 0.53 | 63.50 | 3.69 | 0.20 | 63.25 | 4.11 |
| 265.00 | 6.27 | 0.51 | 0.51 | 68.50 | 3.50 | 0.19 | 68.25 | 3.88 |
| 270.00 | 6.24 | 0.48 | 0.48 | 73.50 | 3.33 | 0.18 | 73.25 | 3.69 |
| 280.00 | 6.21 | 0.45 | 0.45 | 83.50 | 3.05 | 0.17 | 83.25 | 3.36 |
| 290.00 | 6.17 | 0.41 | 0.41 | 93.50 | 2.83 | 0.15 | 93.25 | 3.11 |
| 302.00 | 6.14 | 0.38 | 0.38 | 105.50 | 2.63 | 0.14 | 105.25 | 2.87 |

R-259




023910

**PUMPED WELL ERT-20**
**RECOVERY ANALYSIS:**

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{.38} = 695$ gpd/ft

**PUMPED WELL ERT-20**
**DRAW DOWN ANALYSIS:**

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{.77} = 343$ gpd/ft

**FRENCH LIMITED PROJECT**
**CROSBY, TEXAS**

**FIGURE A2-9**
**SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME**

PUMPED WELL: ERT-20
OBSERVATION WELL: ERT-20
DATE(S): AUG. 9, 1988

| PROJECT No. 26 | DATE | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 10, 1988

PUMPED WELL: ERT-21

TOTAL DEPTH: 50 FEET

SCREENED INTERVAL: 20 FT. TO 50 FT. CASING DIAMETER: 4 IN.

OBSERVATION WELLS: GW-03, radial distance was not measured but was scaled from Plate 4 as about 150 feet from well ERT-21

CONTROL WELLS: ERT-20, REI-6-1, REI-3-3 and REI-3-2

BACKGROUND AND DESCRIPTION OF TEST:

The test of ERT-21 was included to provide information about aquifer characteristics in the vicinity of possible groundwater recovery wells south of the French Limited Lagoon. There were no preliminary pumping testing data upon which to base a pumping rate for the test. The original work plan recommended a pumping rate of four gpm although personnel performing the test could not sustain a four gpm rate at well ERT-20 or at the wells near the REI-10 well cluster. The well did appear to be completed in the more productive portion of the upper alluvial zone as evidenced by wells ERT-7 and ERT-8. Therefore it was decided to attempt to pump the well at a rate of approximately four gpm.

Lithologic and well completion logs and an illustration of the location of the pumped well, ERT-21, and the observation well, GW-03, precede the aquifer test data which follow.

Prior to pumping well ERT-21, the depth to static water level below the top of casing in the pumped well and the observation wells was measured using an electronic well sounder with accuracy to .01 feet. The well was pumped with a submersible pump and water level measurements were taken with an electronic sounder at the pumped well, the observation well and the control wells.

The test was started and the flow as measured by the in-line Rotometer set at 4.1 gpm. Since the water was pumped through a hose to the French Limited Lagoon some distance away, the flow measurements using the bucket and stop watch were taken by personnel monitoring the control wells and were recorded on the control well monitoring forms. Measurements with a bucket and stop watch indicated a relatively constant pumping rate of 3.83 gpm. The pumping test was terminated after eight hours.

Water level measurements were taken with an electronic sounder at the pumped well, the observation well and the control wells. Recovery measurements were taken periodically for four hours after the test. A recovery measurement was also taken 12 hours after termination of the test. Control wells were monitored for water levels about every one-half hour during pumping but were not monitored during recovery. Field measurements for the observation well GW-03 and the control wells are attached.

The drawdown values for the pumped well were determined and corrected using the following correction developed by Jacob (1963) to allow the solutions for confined aquifers to better apply to unconfined conditions:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

The attached data sheet presents the measurements for the pumped well during the pumping and recovery periods. The data sheets include the observed drawdowns and the corrected drawdowns.

As indicated previously, the water produced from the test was pumped through a hose and directly into the French Limited Lagoon.

INTERPRETATION:

The control wells ERT-20, REI 3-2, REI 3-3 and REI 6-1 showed different diurnal patterns as shown in Figure 1. The diurnal fluctuation in well REI 6-1 was greatest at 0.08 feet. No precipitation was recorded during the test. Wells REI 3-2 and REI 3-3 showed a slight drop in water levels during the day. This decline is unlikely to have been related to pumping because observation well GW-3, located much closer to the pumped well, declined by only 0.03 feet during the test. The water levels in control wells ERT-20 and REI 6-1 showed a diurnal pattern similar to that observed in the control wells during the ERT-10 test. The highest water levels appeared between 14:00 and 16:00 (2:00 and 4:00 p.m.) and the lowest levels appeared between 11:00 and 12:00 (11:00 a.m. and 12:00 p.m.). The attached sheet contains data on water level fluctuations for the control wells.

From the pattern of fluctuations seen in the control wells, there is no basis to adjust the measurements in wells ERT-21 and GW-3 for the observed diurnal fluctuations because of the small magnitude of the fluctuations in the control wells and the lack of consistency in the pattern of fluctuations between the control wells.

Based on the "u" parameter criterion, the semi-log techniques would be applicable to nearly the entire data range for the pumped well except that portion subject to well bore storage influences. The time when well bore effects were no longer significant was calculated using the method of Schafer (1978) described in Section B-2.1 and shown below:

$$tc = 0.6(16-1)/(3.83/10.32^*) = 24.3 \text{ minutes}$$

* drawdown at time tc = 25.5 min.

Drawdown and adjusted drawdown values are included in the attached data sheet.

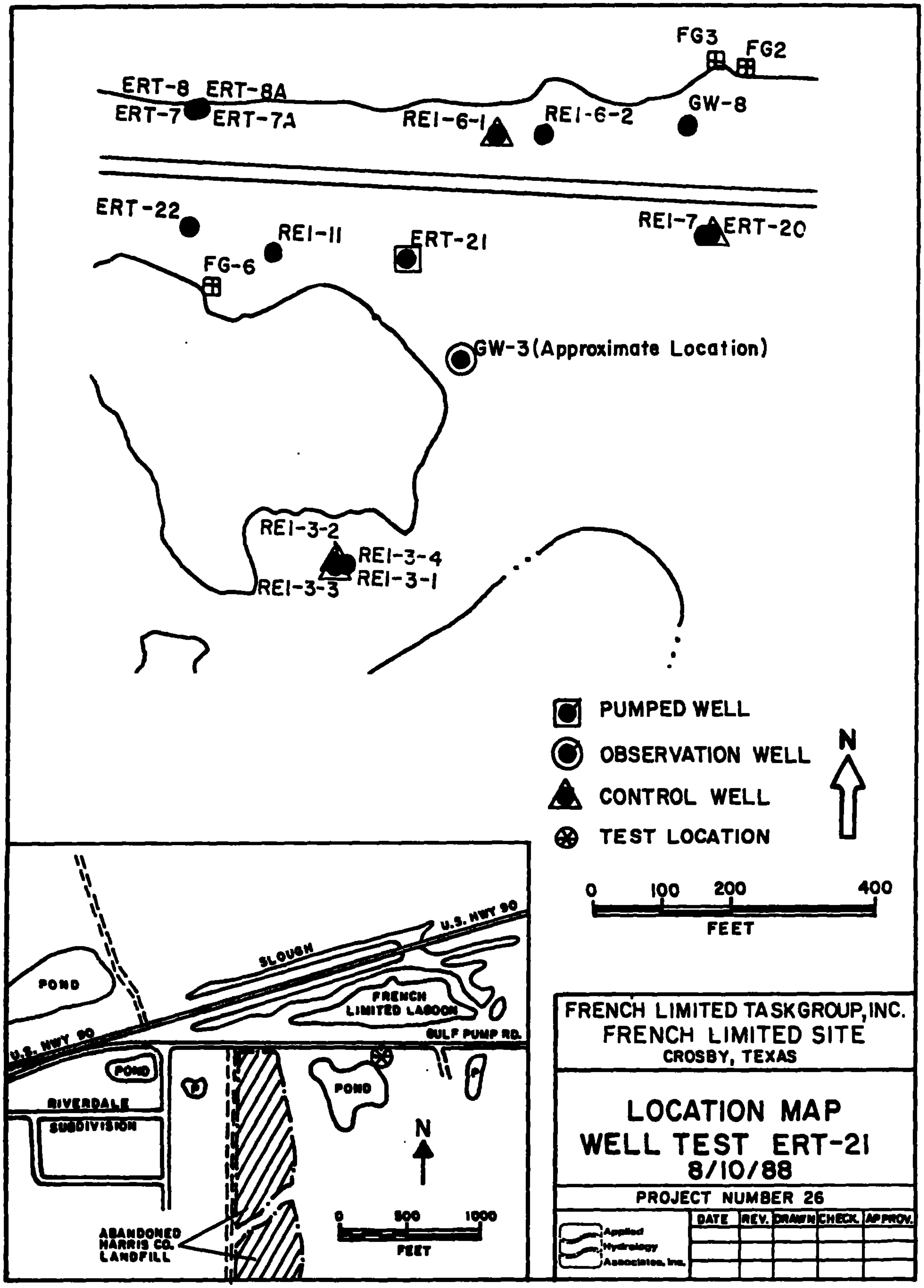
Adjusted drawdown values from the pumped well ERT-21 were plotted against the log of time on the attached Cooper and Jacob (1946) semi-log plot in Figure A2-10. A rise in the water level observed at 120 minutes into the test could not be explained by a change in pumping rate. Measurements of pumping rate taken before and after the rise in water level were consistent. It is possible that the rise was simply a flattening of the drawdown response due to delayed yield effects that are often typical of water table pump test response (see Neuman, 1975).

Well bore storage effects were determined to have influenced the drawdown response during the first 25 minutes of the test. The transmissivity value determined from the response from 25 minutes to 90 minutes (just before the rise in water levels) was 184 gpd/ft. For the drawdown response after the rise at 210 minutes, the calculated transmissivity was 277 gpd/ft.

The water level recovery data from well ERT-21 were analyzed via the Theis (1935) Recovery method on semi-log plots of residual drawdown values adjusted using Jacob's correction versus the log of t/t', where t is time since pumping started and t' is time since pumping stopped. The Theis Recovery plot in Figure A2-11 did not exhibit the fluctuations apparent in the drawdown analyses. Well bore storage effects were determined to have influenced the recovery plot for values of t/t' greater than 20. A straight-line fit to the portion of the residual drawdown curve for values of t/t' less than 20 produced a transmissivity estimate of 595 gpd/ft. It was concluded that the recovery measurements provided the most reliable data for assessing the transmissivity in the vicinity of the ERT-21 well.

The drawdown in well GW-03 due to the constant pumping during the eight-hour test at well ERT-21 was only 0.03 of a foot and could not be satisfactorily matched to a Theis or Boulton curve. Furthermore, the total magnitude of the response was actually less than the natural variability observed in control wells. It appears that if there was an actual response in well GW-03 due to pumping well ERT-21 for eight hours, the magnitude of the response was insufficient to provide an accurate estimate of drawdown response that could be used for a quantitative analysis. The water levels and drawdown data for well GW-03 are attached.

023904



FG3
FG2
ERT-8
ERT-8A
ERT-7
ERT-7A
REI-6-1
REI-6-2
GW-8
ERT-22
REI-7
ERT-20
REI-11
ERT-21
FG-6
GW-3 (Approximate Location)
REI-3-2
REI-3-4
REI-3-3
REI-3-1
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U.S. HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
RIVERDALE SUBDIVISION
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-21
8/10/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV.
DRAWN
CHECK.
APPROV.

02 3975

# ERT

A RESOURCE ENGINEERING COMPANY



## BORING LOG AND CONSTRUCTION OF ERT-21

Client ARCO Chemical Company
Project Name French Site Limited
Project Location Crosby, Texas
Job No. 275-23-01 Boring No. ERT-21
Logged By Steve Preston
Approved By Raaj Patel
Drilled By Gulf Coast Drilling Co. Griller's Name Jim Turner

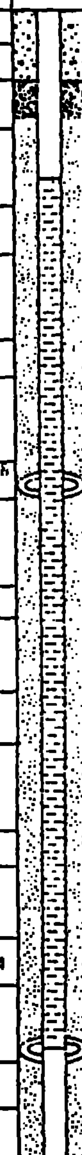
**DRILLING AND SAMPLING INFORMATION**

Date Started 12-23-87 Date Completed 12-23-87
Method Mud Rotary Total Depth 47.0 feet

**WELL COMPLETION INFORMATION**

Screen Dia. 4-inch Ø Length 35.0 feet
Slot Size 0.010 inch Type PVC
Casing Dia. 4-inch Ø Length 7.0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown to black silty to clayey fine sand (SC) (1.5') | - | ST | 0.0 1.5 | - | - | | 3.4 | | |
| | Light brown silty fine to medium sand. (SM-SP) (3.0') | | | | | | | | | |
| 5 | Dark tan and brown clayey fine to medium sand. (SC) (8.0') | - | ST | 3.0 5.0 | - | - | | 4.0 | | |
| 10 | Medium dense to dense light gray fine to medium sand, slightly silty and wet. (SP) | - | ST | 8.0 10.0 | - | - | | 5.4 | | |
| 15 | - Dense with coarse grains from 15.0' | S-1 | SS | 13.5 15.0 | - | 12/15/16 | | 4.4 | | |
| 20 | - Medium dense with coarse grains from 20.0' | - | SS | 18.5 20.0 | - | 10/11/15 | | 3.9h 6.4 | | |
| | - 1-inch thick medium to coarse gravel layer at 24.5' (24.5') | - | SS | 23.5 25.0 | 3.5 last 6 | 2/6/14 | | 3.9 | | |
| 25 | Stiff to very stiff, light gray clay with silt partings and pockets. (CH) (27.0') | | | | | | | | | |
| 30 | Dense olive gray clayey silt. (ML) | S-2 | ST | 28.0 30.0 | 3.0 | - | | 3.4 | | |
| 35 | (38.0') | - | SS | 33.5 35.0 | - | 17/20/24 | | 4.4 | | |
| 40 | Dense light gray and dark tan clayey sand. (SC) (44.0') | - | SS | 38.0 40.0 | - | 16/27/26 | | 14.4 | | |
| 45 | Very stiff dark red and olive gray clay. (CH) (Beaumont clay) (47.0') | S-3 | ST | 43.0 45.0 | 3.5 | - | | 3.4 | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |



**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

021016

Equipment Auger/Rotary Wash

Elevation 13.2 feet Date 4/14/83

| Laboratory Tests | PID (ppm) | Blows/foot | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Description |
|---|---|---|---|---|---|---|
| | | | | | 0 | GRAY CLAYEY SAND (SC) medium dense, moist<br>LIGHT BROWN SAND (SP) medium dense, saturated, medium-fine grained with some clayey sand seams at 3 feet |
| | 1 | 13 | | | 5 | water level on 5/17/84 |
| SG=2.65<br>SA(-#200=5%) | 1 | 25 | | | 10 | |
| Perm K=4.0 x $10^{-3}$ (Remold) | | 42 | 17.6 | 102 | 15 | |
| | 1 | 50/7" | | | 20 | with some gravel seams with trace clay below 18 feet |
| SA(-#200=3%) | 1 | 48 | | | 25 | LIGHT GRAY SANDY SILT (ML) medium dense, saturated, non-plastic, trace clay, fine grained |
| | 1.5 | | | | 30 | |
| | 1 | | 15.3 | 112 | 35 | |
| | 1 | | 19.0 | 101 | 40 | |

(Continuation of Log)

| Laboratory Tests | PID (ppm) | Blows/foot | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Description |
|---|---|---|---|---|---|---|
| | | | | | 40 | |
| | 1.5 | | | | 45 | |
| | 1.2 | | 17.0 | 109 | 50 | |
| | 2.0 | | 26.7 | 92 | 55 | RED-BROWN CLAY (CH) very stiff, saturated |
| | | | | | 60–80 | |

End of Boring - 55 feet
Reamed boring with 8-inch bit to 27 feet. Installed 4-inch diameter PVC well to 27-feet. Screened from 7 to 27 feet. Sand backfill from 5 feet to 27 feet. Well gamma logged after completion

Top of PVC pipe = 15.13 feet

HLA Harding Lawson Associates
Engineers, Geologists & Geophysicists

LOG OF BORING B3 / GW3
French Limited Site
Crosby, Texas

B1

Drawn: [illegible] Job Number: 6013,009.12 Approved: AJPM Date: 5/84 Revised: Date:

B-265

ERT 60317

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-20

Client: APCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 274-23-01 Boring No.: ERT-20
Logged By: Steve Beahm
Approved By: Ron Patel
Drilled By: Gulf Coast Drilling Driller's Name: Jim Turner

DRILLING AND SAMPLING INFORMATION
Date Started: 12-29-87 Date Completed: 12-30-87
Method: Mud Rotary Total Depth: 47.0 Feet

WELL COMPLETION INFORMATION
Screen Dia.: 4-inch ϕ Length: 35.0 Feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch ϕ Length: 7.0 Feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | BLOW COUNTS/ Push Sample | PENETROMETER % RECOVERY READING | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown clayey Silt with roots (ML) | - | ST | - | P.S | - | 0.2 | | |
| | (3.5') | | | | | | | | |
| 5 | Soft dark gray Clay with occasional gravel & roots (CH) | - | ST | - | P.S | - | 0.2 | | |
| | - fine & medium Sand seams & pockets from 9.0' (9.0') | | | | | | | | |
| 10 | Medium dense to dense gray fine to medium clayey Sand (SC) | - | ST | - | P.S | - | 3.2 | | |
| | (14.0') | | | | | | | | |
| 15 | Dense gray fine to medium Sand, slightly silty. (SP) (friable/wet) | - | SS | - | 7/14/14 | - | 3.2 | | |
| 20 | - chemical odor at 20.0' | - | SS | - | 10/14/20 | - | 4.2 | | |
| 25 | - medium to coarse sand with gravel from 24.0' | - | SS | - | 11/17/11 | - | 8.2 | | |
| | (27.5') | | | | | | | | |
| 30 | Stiff dark red and brown Clay (CH) | - | ST | - | P.S. | - | 0.7 | | |
| | (33.0') | | | | | | | | |
| 35 | Dark olive gray clayey Silt (SC) with numerous sand partings and pockets | - | ST | - | P.S. | - | 0.1 | | |
| | (38.0') | | | | | | | | |
| 40 | Dark gray and tan silty fine Sand (SM) with clay pockets & partings | J-1 | SS | 40.0 | 30/50-6 | - | 0.2 | | |
| | (42.0') | | | | | | | | |
| 45 | Very stiff dark red & gray Clay (CH) with slickensides (Beaumont formation) | J-2 | ST | 45.0 | P.S | - | - | | |
| | (47.0') | | | | | | | | |
| 50 | | | | | | | | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

02 39 )8

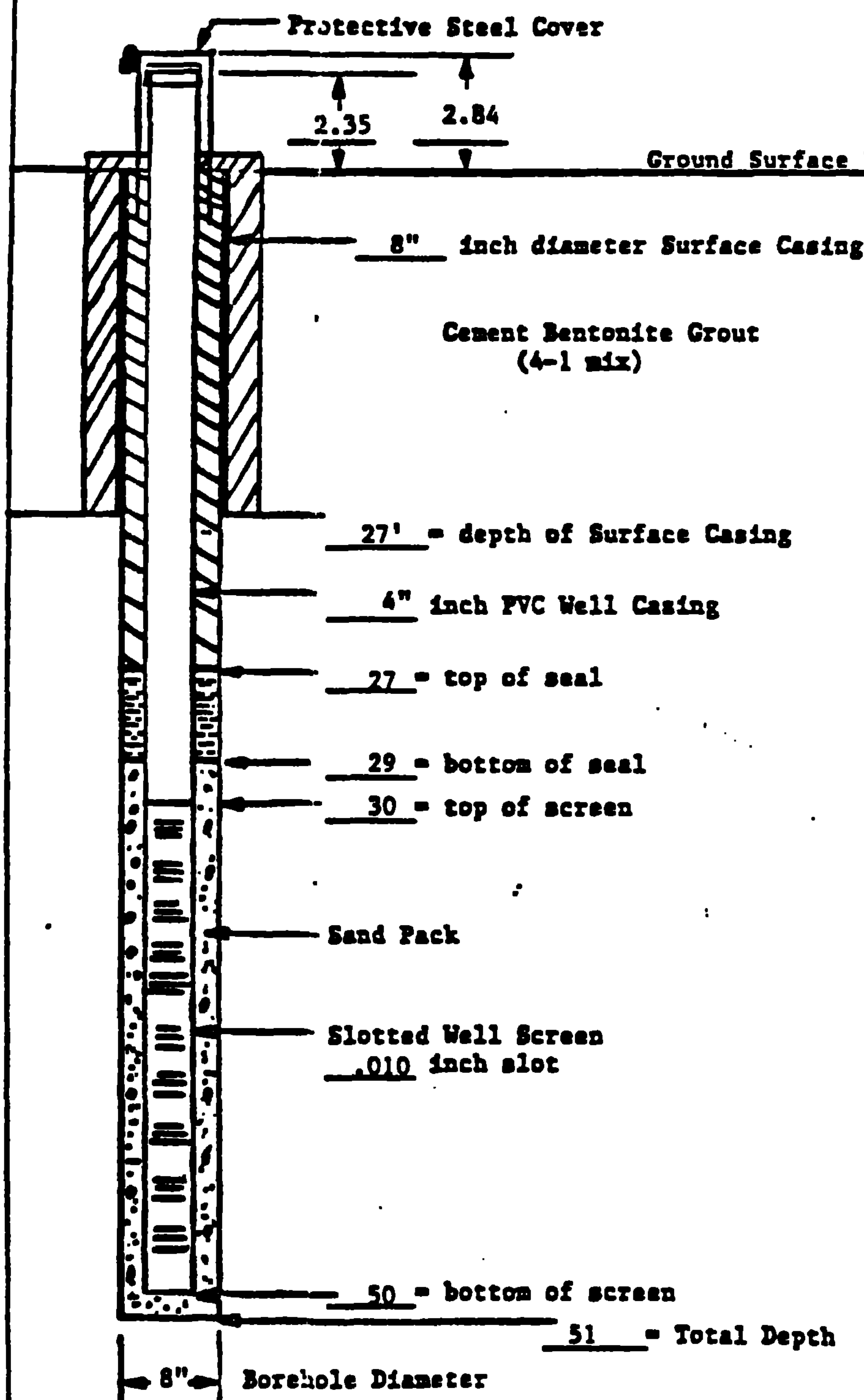
## DETAILS OF MONITOR WELL CONSTRUCTION

**Project Name:** FRENCH LIMITED SITE **Boring Number:** REI:6-1
**Project Number:** 275-02 **Date Installed:** 3-4-84

**Water Level Measurement:** 6.85

**Top of Casing Elev.=** 14.78

**Water Level Elev.=** 7.93 on 4-10-85




| STRATA | DESCRIPTION |
|---|---|
| 4.5 | SILTY CLAYEY SAND (SC) |
| 25.0 | SILTY SAND fine to medium grained with some gravel (SP-SW) |
| 29.7 | SILTY CLAY stiff (CH) |
| 37.5 | SANDY SILT very fine (ML) |
| 46.0 | SILTY CLAYEY SAND, with some thin clay seams (SC-SM) |
| 51.0 | VERY SILTY SANDY CLAY (CL-ML) |
| | SILTY CLAY stiff (CH) |

RESOURCE ENGINEERING

023909

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client: FRENCH LIMITED TASK FORCE
Boring #: REI:6-1
Architect Engineer: C. Itin
Job #: 27502
Project Name: French Site
Drawn By: JB
Project Location: Crosby, Texas
Approved By: JDA

DRILLING and SAMPLING INFORMATION

Date Started: 3-2-84 — Hammer Wt.: 140 lbs.
Date Completed: 3-3-84 — Hammer Drop: 30 in.
Drill Foreman: G. Littel — Spoon Sampler OD: 2 in.
Inspector: JB — Rock Core Dia.: - in.
Boring Method: RW/HSA — Shelby Tube OD: 3 in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION – 13.0

| Soil Classification | Stratum Depth | Depth Scale | Sample No. | Sample Type | % Recovery | Ground Water | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qu Tons/Ft.² / Pocket Penetrometer qp Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY CLAYEY SAND, fine grained, brown to gray, with some thin silty clay seams. | | | 01 | SS | 39 | | 10 | | | | | |
| (SM-SC) (-)200 = 20% | | | 02 | SS | 56 | | 8 | | | | | |
| (-)200 = 12.6% | 4.5 | | 03 | SS | 56 | | 4 | | | | | |
| SAND, medium to fine grained, gray. | | 5 | 04 | SS | 67 | | 3 | | | | | |
| (-)200 = 5.2% | | | 05 | SS | 56 | | 1 | | | | | |
| (-)200 = 2.9% | | | 06 | SS | 67 | | 7 | | | | | |
| | | 10 | 07 | SS | 56 | | 11 | | | | | |
| | | | 08 | SS | 39 | | 15 | | | | | |
| (-)200 = 2.9% | | | 09 | SS | 33 | | 18 | | | | | |
| (SP-SW) (-)200 = 2.6% | | | 10 | SS | 56 | | 16 | | | | | |
| (-)200 = 1.8% (-)200 = 2.8% | | 15 | 11 | SS | 61 | | 11 | | | | | |
| (-)200 - 2.1% (-)200 = 2.4% | | | 12 | SS | 67 | | 8 | | | | | |
| | | | 13 | SS | 56 | | 10 | | | | | |
| | | 20 | 14 | SS | 61 | | 12 | | | | | |
| | | | 15 | SS | 39 | | 12 | | | | | |
| SILTY CLAY, yellow brown to gray mottles (CH-CL) | | | 16 | SS | 67 | | 13 | | | | | |
| | 25.0 | 25 | 17 | SS | 56 | | 5 | | | | | |

Continued on page 2

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▼ AT COMPLETION 5.4 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

023910

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client FRENCH LIMITED TASK FORCE — Boring # REI:6-1
Architect Engineer C. Itin — Job # 27502
Project Name French Site — Drawn By JB
Project Location Crosby, Texas — Approved By JDA

DRILLING and SAMPLING INFORMATION

Date Started 3-2-84 — Hammer Wt. 140 lbs.
Date Completed 3-3-84 — Hammer Drop 30 in.
Drill Foreman G. Littel — Spoon Sampler OD 2 in.
Inspector JB — Rock Core Dia. - in.
Boring Method RW — Shelby Tube OD 3 in.

TEST DATA

| SOIL CLASSIFICATION / SURFACE ELEVATION — | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qu Tons/Ft.² / Pocket Penetrometer qp Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY CLAY, yellow brown to gray, mottles, with thin silt & sand seams. (CH-CL) (-)200 = 98.1% | | | 18 | SS | 94 | | 7 | | | | 36.3% | LL=70 PL=27 PI=57 |
| (-)200 = 81.3% | | | 19 | SS | 67 | | 21 | | | | 35.7% | LL=44 PL=21 PI=28 |
| | 29.7 | | 20 | SS | 33 | | 11 | | | | | |
| SANDY CLAYEY SILT very fine grained, olive to gray. | | 30 | 21 | SS | 67 | | 27 | | | | | |
| | | | 22 | SS | 67 | | 31 | | | | | |
| (ML) (-)200 = 54% (-)200 = 57% | | | 23 | SS | 67 | | 20 | | | | | |
| | | 35 | 24 | SS | 67 | | 23 | | | | | |
| (-)200 = 49% H velwli | 37.5 | | 25 | SS | 89 | | 23 | | | | | |
| SILTY CLAYEY SAND, fine grained, very fine grained, olive gray, with thin silty clay seams, & oily streaks and stains. | | | 26 | SS | 78 | | 22 | | | | | |
| | | 40 | 27 | SS | 33 | | 20 | | | | | |
| (SC-SM) (-)200 = 53% (-)200 = 41% | | | 28 | SS | 67 | | 27 | | | | | |
| (-)200 = 60% | | | 29 | SS | 67 | | 28 | | | | | |
| odor @ 40' | | | 30 | SS | 67 | | 48 | | | | | |
| silty BLK STAINS @ 45' | 46 | 45 | 31 | SS | 83 | | 37 | | | | 20.8 | LL=26 PL=18 PI=8 |
| VERY SILTY SANDY CLAY/CLAYEY SANDY SILT, red brown to gray with thin silt & sand seams. | | | 32 | SS | 89 | | 20 | | | | | |
| (CL-ML) (-)200 = 84% (-)200 = 51% | | | 33 | SS | 95 | | 17 | | | | | |
| Change to Silty Clay | 51.0 | 50 | 34 | SS | 95 | | 19 | | | | 16.9 | LL=23 PL=15 PI=8 |
| Continued on page 3 | | | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 5.4 FT.
▽ AFTER HRS. FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

023911

**RESOURCE ENGINEERING INCORPORATED**



# SUBSURFACE EXPLORATION RECORD

Client: French Limited Task Force — Boring #: REI:6-1
Architect Engineer: C.Irin — Job #: 275-02
Project Name: French Site — Drawn By: JB
Project Location: Crosby, Texas — Approved By: JDA

DRILLING and SAMPLING INFORMATION

Date Started: 3-2-85 — Hammer Wt.: 140 lbs.
Date Completed: 3-3-85 — Hammer Drop: 30 in.
Drill Foreman: G.Littel — Spoon Sampler OD: 2 in.
Inspector: JB — Rock Core Dia.: – in.
Boring Method: RW — Shelby Tube OD: 30 in.

TEST DATA

| SOIL CLASSIFICATION / SURFACE ELEVATION – | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qU Tons/Ft.² / Pocket Penetrometer qU Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY SANDY CLAY/CLAYEY SILT (CL-ML) | 51.0 | | | | | | | | | | | |
| SILTY CLAY, redbrown to gray mottles, stiff with silt seams (-)200= 98% (CH-CL) | | | 35 | SS | 95 | | 16 | | | | | LL=62 |
| | | | 36 | SS | 95 | | 19 | | | | | PL=21 PI=41 |
| | | 55 | 37 | SS | 95 | | 17 | | | | | LL=39 |
| | 56.5 | | 38 | SS | 95 | | 20 | | | | | PL=20 PI=19 |
| VERY CLAYEY SILT, redbrown to gray, stiff with very thin silt seams (MH) | | | 39 | SS | 100 | | 9 | | | | | LL=51 |
| | | | 40 | SS | 95 | | 9 | | | | | PL=20 |
| | | 60 | 41 | SS | 75 | | 9 | | | | | PI=19 |
| Boring Terminated at 61ft. (EI.-48.0) | | 65 70 75 | | | | | | | | | | |

Well TD Screen
6-1 51 31-51
6-2 25 5-25

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▼ AT COMPLETION 5.4 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

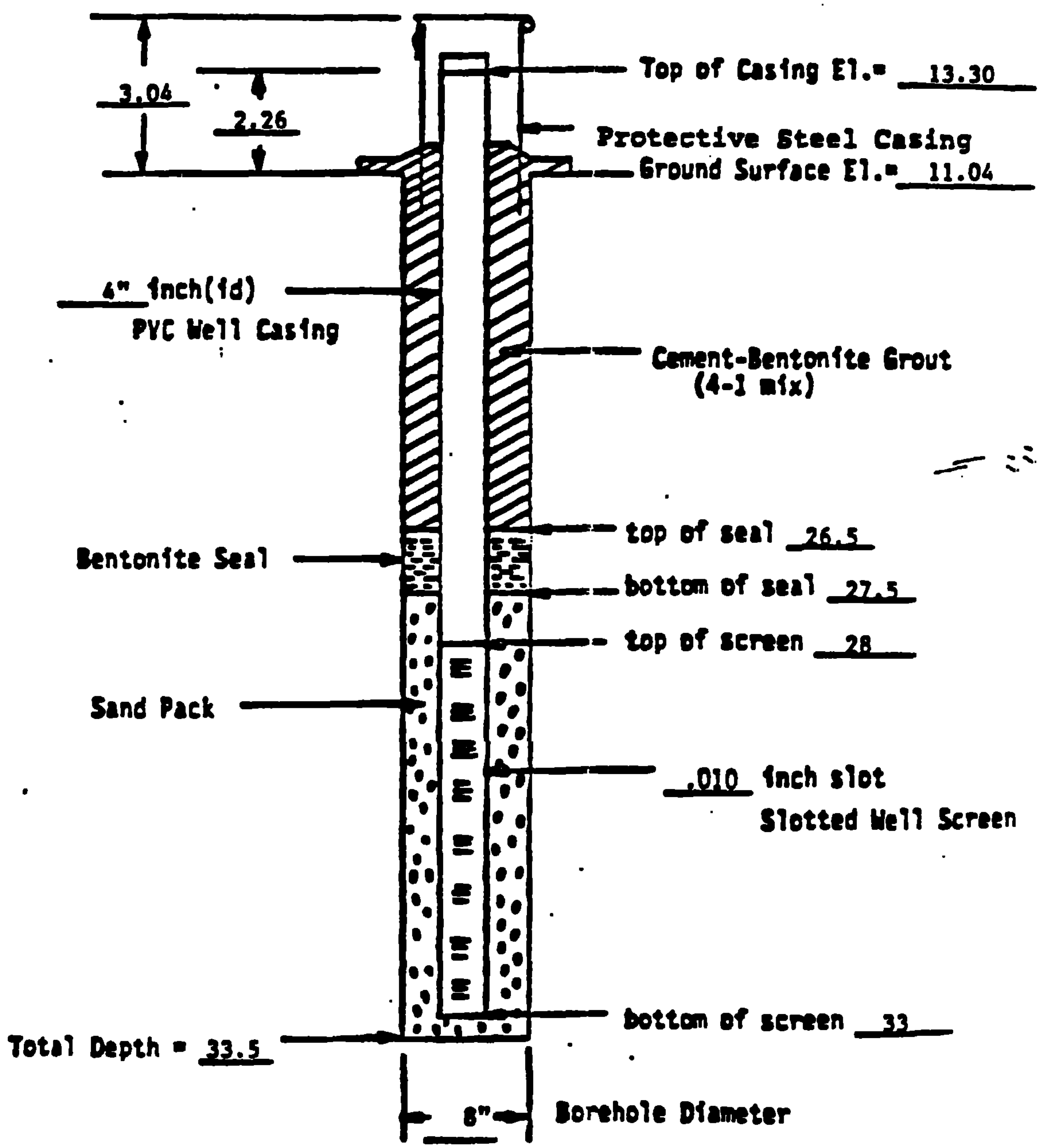
023912

# Details of Monitor Well Construction

Project Name: FRENCH LIMITED SITE  Boring Number: REI:3-2

Project Number: 275-02  Date Installed: 2-25-84

Water Level Measurement: 5.13 (El. = 3.17 on 4-12-84)




REI

02?913

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client FRENCH LIMITED TASK FORCE  Boring # REI:3-2
Architect Engineer C.Itin  Job # 27511
Project Name French Site  Drawn By JB
Project Location Crosby , Texas  Approved By

DRILLING and SAMPLING INFORMATION

Date Started 5/13/85  Hammer Wt. 140 lbs.
Date Completed 5/13/85  Hammer Drop 30 in.
Drill Foreman G.Littel  Spoon Sampler OD 2 in.
Inspector JB  Rock Core Dia. – in.
Boring Method SFA  Shelby Tube OD 3 in.

TEST DATA

| SOIL CLASSIFICATION<br>SURFACE ELEVATION – (10.9) | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qu Tons/Ft.² Pocket Penetrometer qp Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY SAND, fine grained, tan (SM) | 4.0 | | | | | | | | | | | |
| CLAYEY SILTY SAND, fine grained, gray (SC) | 7.0 | 5 | | | | | | | | | | |
| SAND, fine to medium grained, gray (SP-SW) | | 10 15 20 | | | | | | | | | | |
| VERY SILTY SANDY CLAY with thin silt seams (CL-ML) | 23.0 | | | | | | | | | | | |
| Boring continued on page 2 | | 25 | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▼ AT COMPLETION 5.3 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

0??914

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client: FRENCH LIMITED TASK FORCE  Boring #: REI:3-2
Architect Engineer: C.Itin  Job #: 27511
Project Name: French Site  Drawn By: JB
Project Location: Crosby, Texas  Approved By:

DRILLING and SAMPLING INFORMATION

Date Started: 5/13/85  Hammer Wt.: 140 lbs.
Date Completed: 5/13/85  Hammer Drop: 30 in.
Drill Foreman: G. Littel  Spoon Sampler OD: 2 in.
Inspector: JB  Rock Core Dia.: – in.
Boring Method: SFA  Shelby Tube OD: 3 in.

TEST DATA

| SOIL CLASSIFICATION<br>SURFACE ELEVATION – (-14.1) | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qu Tons/Ft.² / Pocket Penetrometer qp Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit, PL = Plastic Limit, SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VERY SILTY SANDY CLAY, with thin silty seams (CL-ML) | 27.0 | | | | | | | | | | | |
| CLAYEY SILTY SAND, fine grained tan to gray (SC-ML) -200 = 31% -200 = 48% | | | 01 | SS | 67 | | 23 | | | | | |
| | | 30 | 02 | SS | 50 | | 16 | | | | | |
| Change to Silty Clay at 31.0' | | | | | | | | | | | | |
| Boring Terminated at 31 ft. (El. = -20.1) | | 35 | | | | | | | | | | |
| | | 40 | | | | | | | | | | |
| | | 45 | | | | | | | | | | |
| | | 50 | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 5.3 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

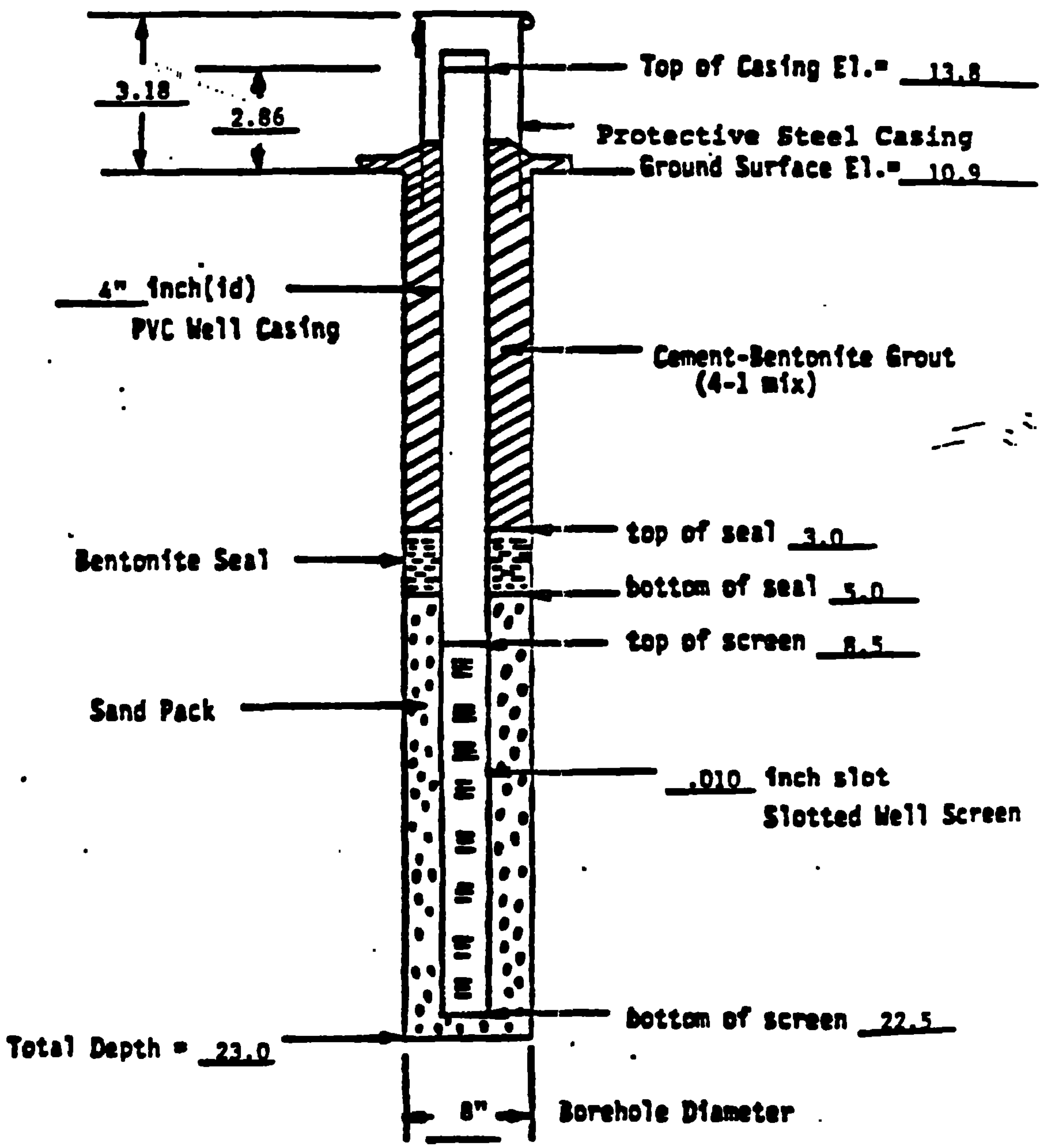
BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

## Details of Monitor Well Construction

Project Name: FRENCH LIMITED SITE  Boring Number: REI:3-3

Project Number: 275-02  Date Installed: 2-24-84

Water Level Measurement: 5.60 (El. = 8.2 on 4-12-84)




REI

02?916

RESOURCE ENGINEERING INCORPORATED



# SUBSURFACE EXPLORATION RECORD

Client: FRENCH LIMITED TASK FORCE
Boring #: REI:3-3
Architect Engineer: C.Itin
Job #: 27511
Project Name: French Site
Drawn By: JB
Project Location: Crosby, Texas
Approved By:

DRILLING and SAMPLING INFORMATION

Date Started: 5/13/85 Hammer Wt.: 140 lbs.
Date Completed: 5/13/85 Hammer Drop: 30 in.
Drill Foreman: G.Littel Spoon Sampler OD: 2 in.
Inspector: JB Rock Core Dia.: - in.
Boring Method: SFA Shelby Tube OD: 3 in.

TEST DATA

| SOIL CLASSIFICATION<br>SURFACE ELEVATION – (10.9) | Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength qU Tons/Ft.² / Pocket Penetrometer qP Tons/Ft.² | Permeability X 10⁻ cm/sec | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SILTY SAND, fine grained, tan (SM) | 4.0 | | | | | | | | | | | |
| CLAYEY SILTY SAND, fine grained, gray (SC) | 7.0 | 5 | | | | | | | | | | |
| SAND, fine to medium grained gray (SP-SW) -200 = 2.3% | | 10, 15 | | | | | | | | | | |
| | | | 01 | SS | 33 | | 14 | | | | | |
| | | 20 | NR | ST | 0 | | | | | | | |
| Boring Terminated at 23' (El.= -12.1) | | 25 | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 5.3 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

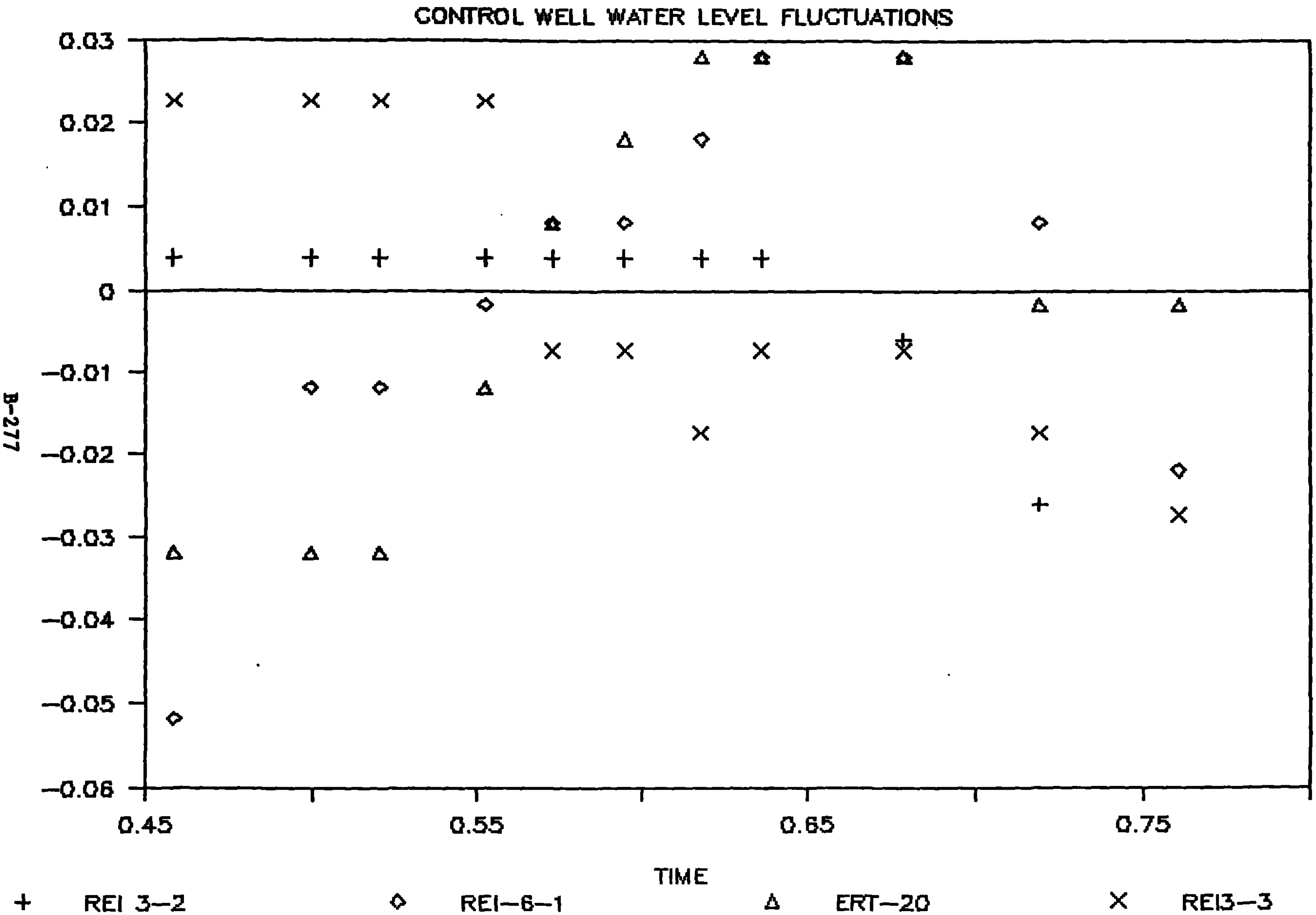
021917

PUMPED WELL: ERT-21

CONTROL WELL WATER LEVEL FLUCTUATIONS

| HOUR | min | REI3-3 | MEAN-DEV REI3-3 5.402 | REI3-2 | MEAN-DEV REI3-2 4.924 | REI6-1 | MEAN-DEV REI6-1 6.108 | ERT-20 | MEAN-D ERT-20 6.118 |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 0 | 5.38 | 0.022 | | | | | | |
| 11 | 59 | 5.38 | 0.022 | | | | | | |
| 12 | 29 | 5.38 | 0.022 | | | | | | |
| 13 | 15 | 5.38 | 0.022 | | | | | | |
| 13 | 45 | 5.41 | -0.00 | | | | | | |
| 14 | 16 | 5.41 | -0.00 | | | | | | |
| 14 | 49 | 5.42 | -0.01 | | | | | | |
| 15 | 15 | 5.41 | -0.00 | | | | | | |
| 16 | 16 | 5.41 | -0.00 | | | | | | |
| 17 | 15 | 5.42 | -0.01 | | | | | | |
| 18 | 15 | 5.43 | -0.02 | | | | | | |
| 12 | 0 | | | 4.92 | 0.004 | | | | |
| 12 | 30 | | | 4.92 | 0.004 | | | | |
| 13 | 15 | | | 4.92 | 0.004 | | | | |
| 13 | 50 | | | 4.92 | 0.004 | | | | |
| 14 | 15 | | | 4.92 | 0.004 | | | | |
| 14 | 48 | | | 4.92 | 0.004 | | | | |
| 15 | 16 | | | 4.92 | 0.004 | | | | |
| 16 | 15 | | | 4.92 | 0.004 | | | | |
| 17 | 16 | | | 4.93 | -0.00 | | | | |
| 18 | 16 | | | 4.95 | -0.02 | | | | |
| 15 | 33 | | | | | 6.08 | 0.028 | | |
| 16 | 1 | | | | | 6.08 | 0.028 | | |
| 17 | 0 | | | | | 6.1 | 0.008 | | |
| 18 | 0 | | | | | 6.13 | -0.02 | | |
| 11 | 23 | | | | | 6.16 | -0.05 | | |
| 12 | 31 | | | | | 6.12 | -0.01 | | |
| 13 | 1 | | | | | 6.12 | -0.01 | | |
| 13 | 31 | | | | | 6.11 | -0.00 | | |
| 14 | 0 | | | | | 6.1 | 0.008 | | |
| 14 | 32 | | | | | 6.1 | 0.008 | | |
| 15 | 0 | | | | | 6.09 | 0.018 | | |
| 15 | 29 | | | | | | | 6.09 | 0.028 |
| 16 | 0 | | | | | | | 6.09 | 0.028 |
| 18 | 0 | | | | | | | 6.12 | -0.00 |
| 19 | 0 | | | | | | | 6.12 | -0.00 |
| 10 | 50 | | | | | | | 6.15 | -0.03 |
| 12 | 30 | | | | | | | 6.15 | -0.03 |
| 13 | 0 | | | | | | | 6.15 | -0.03 |
| 13 | 30 | | | | | | | 6.13 | -0.01 |
| 14 | 4 | | | | | | | 6.11 | 0.008 |
| 14 | 30 | | | | | | | 6.1 | 0.018 |
| 15 | 4 | | | | | | | 6.09 | 0.028 |

# AQUIFER PUMP TEST WELL ERT-21



# STEP DRAWDOWN TEST - WELL ERT-21

Saturated Thickness 45.12 feet

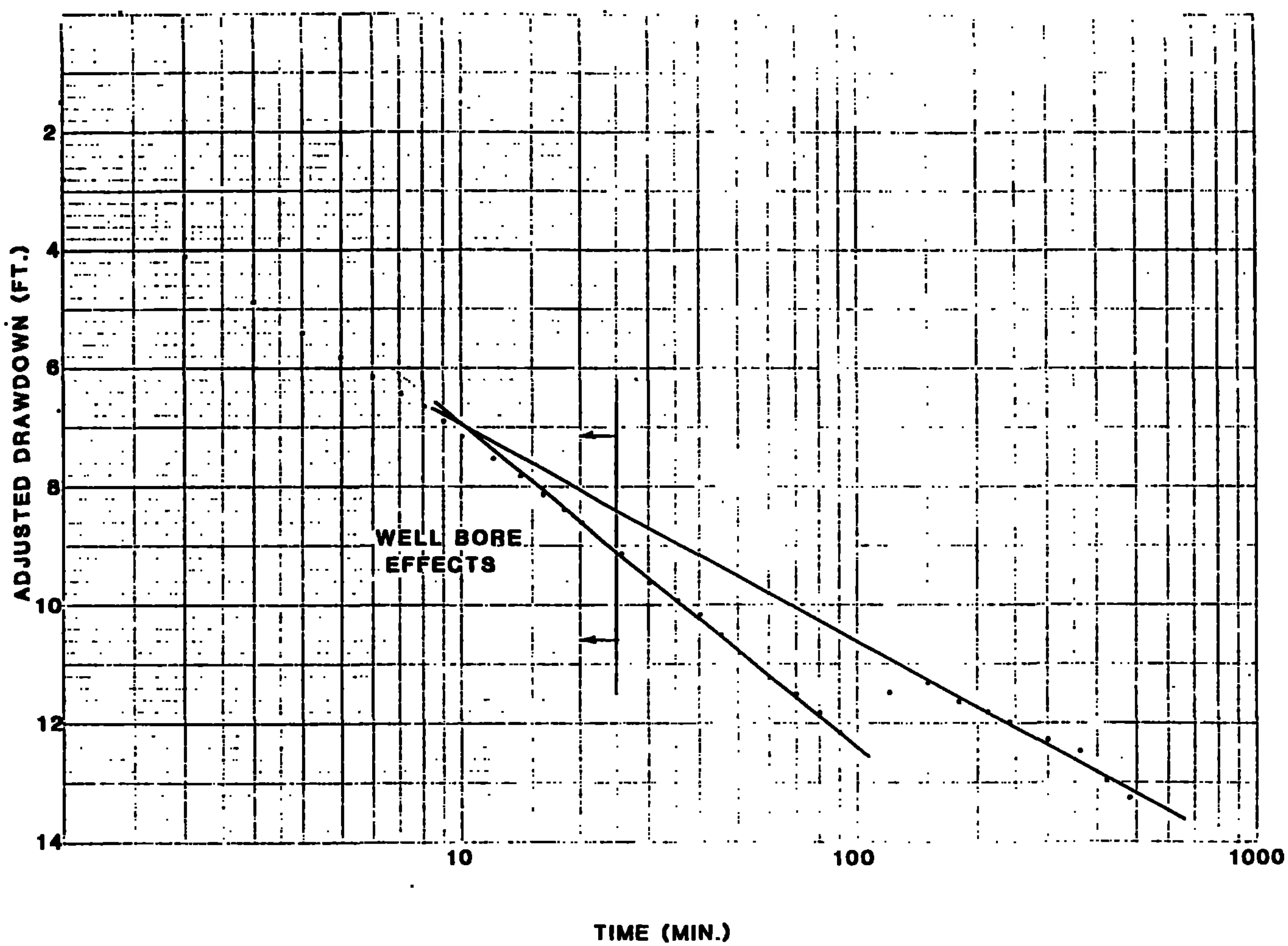
static water level 4.88 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 0 | 4.88 | 0 | 0.00 | | |
| 0.5 | 6.8 | 1.92 | 1.88 | | |
| 1 | 7.74 | 2.86 | 2.77 | | |
| 2 | 9.15 | 4.27 | 4.07 | | |
| 3 | 10.02 | 5.14 | 4.85 | | |
| 4 | 10.64 | 5.76 | 5.39 | | |
| 5 | 11.12 | 6.24 | 5.81 | | |
| 6 | 11.51 | 6.63 | 6.14 | | |
| 7 | 11.83 | 6.95 | 6.41 | | |
| 8 | 12.1 | 7.22 | 6.64 | | |
| 9 | 12.4 | 7.52 | 6.89 | | |
| 10 | 12.7 | 7.82 | 7.14 | | |
| 12 | 13.15 | 8.27 | 7.51 | | |
| 14 | 13.5 | 8.62 | 7.80 | | |
| 16 | 13.9 | 9.02 | 8.12 | | |
| 18 | 14.21 | 9.33 | 8.37 | | |
| 20 | 14.5 | 9.62 | 8.59 | | |
| 25.5 | 15.2 | 10.32 | 9.14 | | |
| 30 | 15.79 | 10.91 | 9.59 | | |
| 35 | 16.2 | 11.32 | 9.90 | | |
| 40 | 16.57 | 11.69 | 10.18 | | |
| 45 | 17 | 12.12 | 10.49 | | |
| 50 | 17.45 | 12.57 | 10.82 | | |
| 60 | 18.02 | 13.14 | 11.23 | | |
| 70 | 18.44 | 13.56 | 11.52 | | |
| 80 | 18.86 | 13.98 | 11.81 | | |
| 90 | 19.33 | 14.45 | 12.14 | | |
| 120 | 18.31 | 13.43 | 11.43 | | |
| 150 | 18.15 | 13.27 | 11.32 | | |
| 180 | 18.56 | 13.68 | 11.61 | | |
| 210 | 18.82 | 13.94 | 11.79 | | |
| 240 | 19.08 | 14.2 | 11.97 | | |
| 300 | 19.5 | 14.62 | 12.25 | | |
| 360 | 19.8 | 14.92 | 12.45 | | |
| 420 | 20.57 | 15.69 | 12.96 | | |
| 480 | 20.97 | 16.09 | 13.22 | | |
| 480.5 | 19.58 | 14.7 | 12.31 | 0.50 | 961.00 |
| 481 | 18.67 | 13.79 | 11.68 | 1.00 | 481.00 |
| 482 | 16.52 | 11.64 | 10.14 | 2.00 | 241.00 |
| 483 | 14.46 | 9.58 | 8.56 | 3.00 | 161.00 |
| 484 | 13.17 | 8.29 | 7.53 | 4.00 | 121.00 |
| 485 | 11.87 | 6.99 | 6.45 | 5.00 | 97.00 |
| 486 | 11.03 | 6.15 | 5.73 | 6.00 | 81.00 |
| 487 | 10.09 | 5.21 | 4.91 | 7.00 | 69.57 |
| 488 | 9.26 | 4.38 | 4.17 | 8.00 | 61.00 |

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|
| 489 | 8.67 | 3.79 | 3.63 | 9.00 | 54.33 |
| 490 | 8.23 | 3.35 | 3.23 | 10.00 | 49.00 |
| 492 | 7.64 | 2.76 | 2.68 | 12.00 | 41.00 |
| 494 | 7.28 | 2.4 | 2.34 | 14.00 | 35.29 |
| 496 | 7.02 | 2.14 | 2.09 | 16.00 | 31.00 |
| 498 | 6.86 | 1.98 | 1.94 | 18.00 | 27.67 |
| 500 | 6.72 | 1.84 | 1.80 | 20.00 | 25.00 |
| 505 | 6.45 | 1.57 | 1.54 | 25.00 | 20.20 |
| 510 | 6.25 | 1.37 | 1.35 | 30.00 | 17.00 |
| 515 | 6.12 | 1.24 | 1.22 | 35.00 | 14.71 |
| 520 | 5.99 | 1.11 | 1.10 | 40.00 | 13.00 |
| 525 | 5.91 | 1.03 | 1.02 | 45.00 | 11.67 |
| 530 | 5.8 | 0.92 | 0.91 | 50.00 | 10.60 |
| 540 | 5.71 | 0.83 | 0.82 | 60.00 | 9.00 |
| 550 | 5.57 | 0.69 | 0.68 | 70.00 | 7.86 |
| 560 | 5.48 | 0.6 | 0.60 | 80.00 | 7.00 |
| 575 | 5.38 | 0.5 | 0.50 | 95.00 | 6.05 |
| 600 | 5.28 | 0.4 | 0.40 | 120.00 | 5.00 |
| 630 | 5.21 | 0.33 | 0.33 | 150.00 | 4.20 |
| 660 | 5.14 | 0.26 | 0.26 | 180.00 | 3.67 |
| 690 | 5.11 | 0.23 | 0.23 | 210.00 | 3.29 |
| 720 | 5.07 | 0.19 | 0.19 | 240.00 | 3.00 |
| 1200 | 4.94 | 0.06 | 0.06 | 720.00 | 1.67 |

022831

B-280




**PUMPED WELL ERT-21**
**DRAW DOWN ANALYSIS**

Before 90 Minutes:

$T = \frac{264\ Q}{S}$ gpd/ft

$= \frac{264\ (3.83)}{5.5} = 184$ gpd/ft

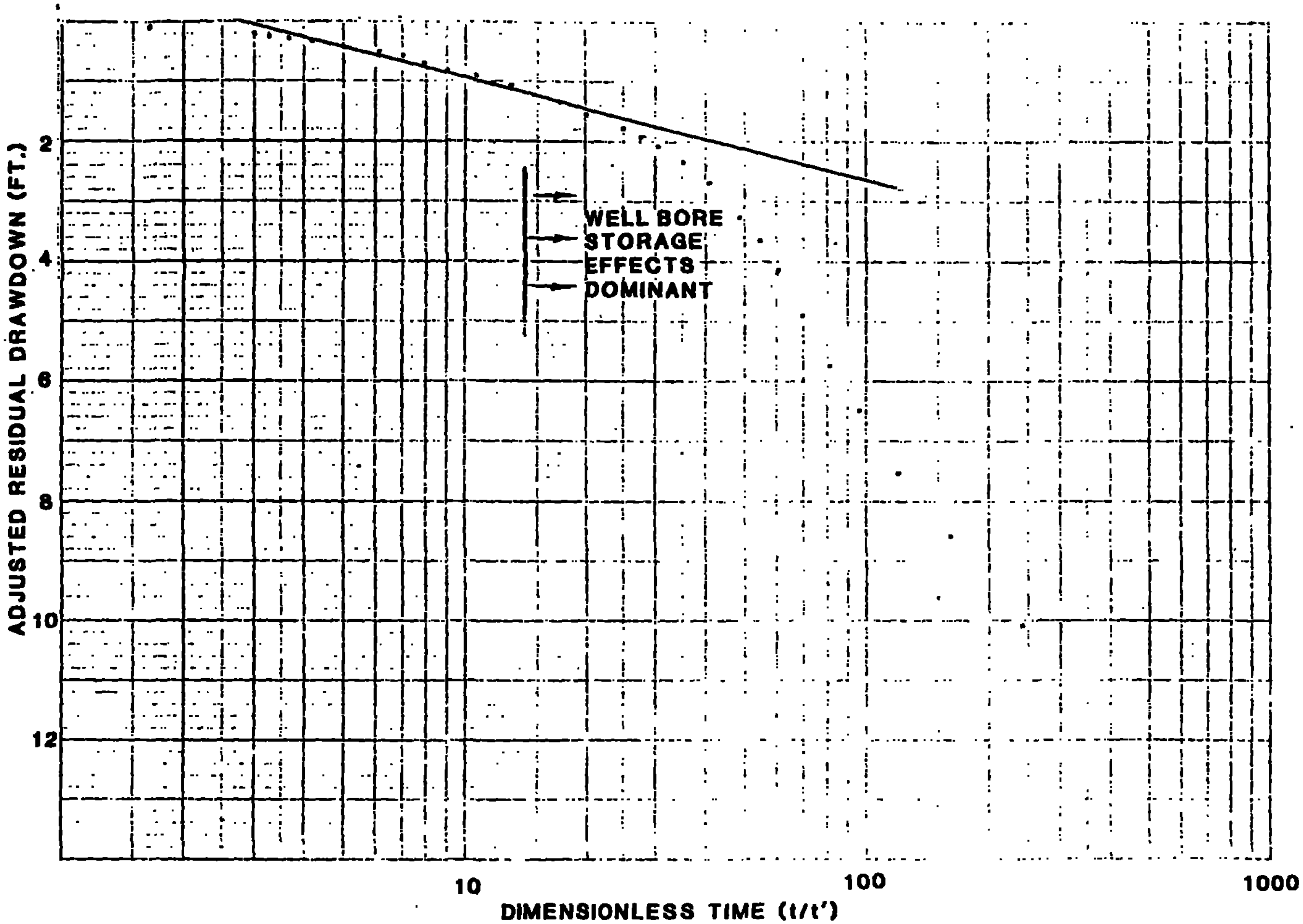
After 90 minutes:

$T = \frac{264}{S}\ Q$ gpd/ft

$T = \frac{264\ (3.83)}{3.65} = 277$ gpd/ft

| FRENCH LIMITED PROJECT<br>CROSBY, TEXAS | | |
|---|---|---|
| FIGURE A2-10<br>SEMI-LOG DRAWDOWN ANALYSIS<br>PUMPED WELL: ERT-21<br>OBSERVATION WELL: ERT-21<br>DATE(S): AUG. 10, 1988 26 | | |
| PROJECT No. 26 | DATE | REVISION |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.




B-281

PUMPED WELL ERT-21
RECOVERY ANALYSIS

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$T = \frac{264\ (3.83)}{1.7} = 595$ gpd/ft

| | | |
|---|---|---|
| FRENCH LIMITED PROJECT<br>CROSBY, TEXAS | | |
| FIGURE A2-11<br>THEIS RECOVERY ANALYSIS<br>PUMPED WELL: ERT-21<br>OBSERVATION WELL: ERT-21<br>DATE(S): AUG. 10, 1988 | | |
| PROJECT No. 26 | DATE | REVISION |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

2:6:0:0

023923

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 11, 1988

PUMPED WELL: ERT-22

OBSERVATION WELLS: none

CONTROL WELLS: ERT-23, ERT-7A and ERT-7

BACKGROUND AND DESCRIPTION OF TEST:

The test of well ERT-22 was not in the original Work Plan for pump testing the shallow alluvial aquifer zone. This well was included to help address concerns by EPA and Jacobs Engineering about the nature and extent of a higher transmissive zone south of the French Limited Lagoon near the ERT-7 and ERT-8 wells.

There were no preliminary pumping testing data upon which to base a pumping rate for the test. The original Work Plan recommended a pumping rate of four gpm. Since the well did appear to be in the more productive portion of the alluvial aquifer similar to wells ERT-21, ERT-7 and ERT-8, personnel performing the aquifer test decided to attempt to pump the well at a rate of approximately four gpm.

Heavy rain occurred for about three hours prior to the start up of the test and was responsible for delaying the start of testing. A canopy cover was purchased and placed over the pumping well and generator and the test was started at about 16:40 (4:40 p.m.). Intermittent rain fell during the pumping period and recovery period. Total storm event rainfall was estimated at 1.25 inches.

Since the water was pumped through a hose to the French Limited Lagoon some distance away, the flow measurements using the bucket and stop watch were taken by personnel monitoring the control wells and were recorded on the control well monitoring forms. Measurements with a bucket and stop watch indicated a relatively constant pumping rate of 4.35 gpm. This pumping rate could not be sustained and was cut back to 2.4 gpm and held at this rate for 270 minutes. The variable pumping rate was not considered to pose problems for interpretation since this was a single well test. Also, it was thought that the variable rate test would help discriminate the drawdown due to formations loss from that due to well inefficiency. The pumping rate was increased to 2.88 gpm for the last 90 minutes of the pump test. Total pumping time for the test was seven hours.

Recovery measurements were taken periodically for eight hours after termination of pumping. Control wells were monitored for water levels about every one-half hour during pumping and for 1.5 hours into the recovery period. A water level measurement of the control wells was also taken after eight hours of recovery. Water level measurement data are attached.

INTERPRETATION:

The control wells ERT-7, ERT-7A and ERT-23 showed no obvious response due to pumping well ERT-29. The water levels in all three wells rose throughout the monitoring period for the test including the recovery period. The total water level rise in the control wells from the start of the test was from 0.2 to 0.3 feet as shown in the plot of control well water level fluctuation. These changes were large enough to require adjustment of the drawdown in the pumped well in order to interpret these results.

The average fluctuation from the three control wells was used to adjust the water level measurements in the pumped well.

Drawdown values determined from the water level measurements adjusted for the precipitation recharge influence in the production well ERT-22 were adjusted using Jacob's (1963) correction for water table conditions:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

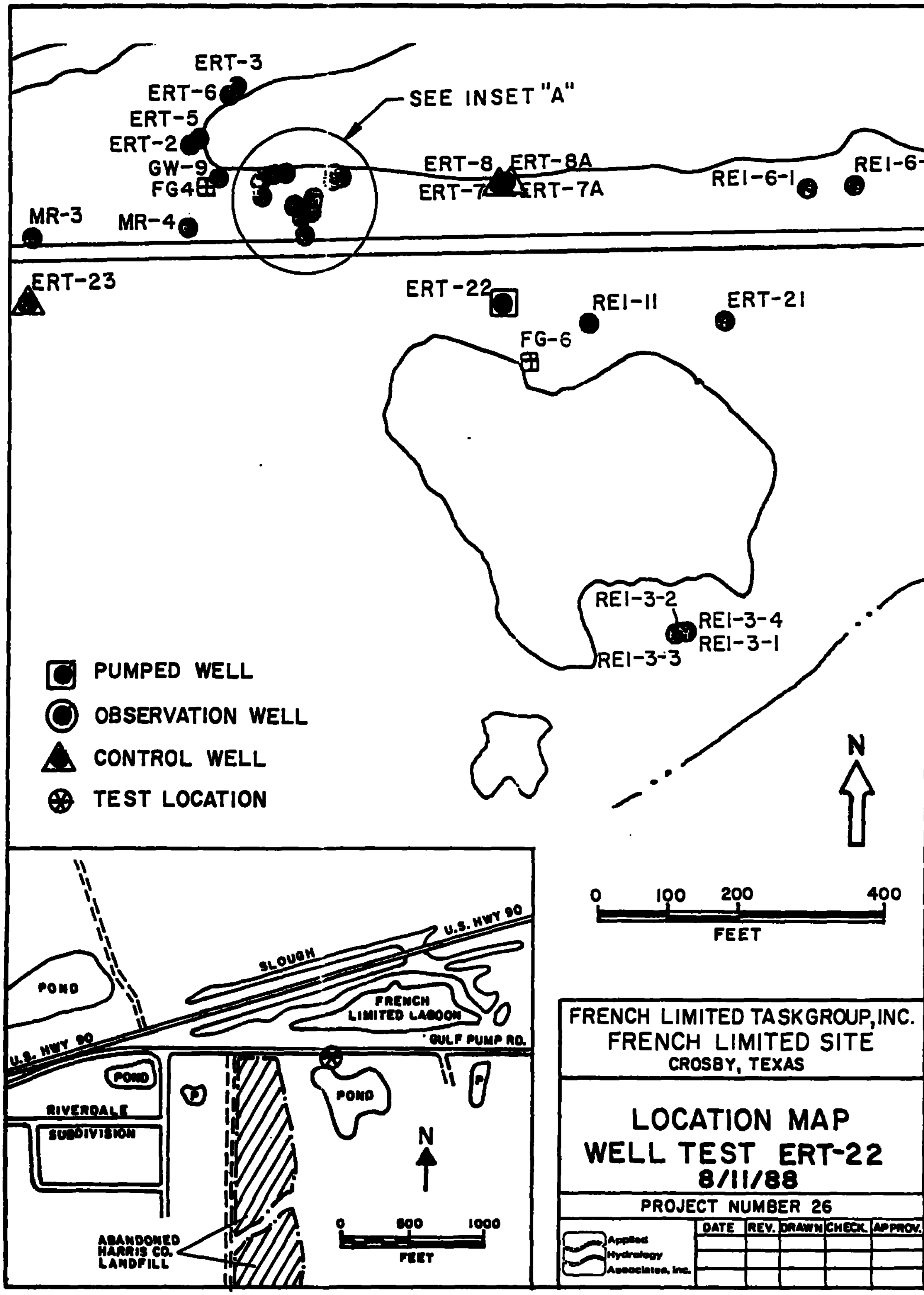
Drawdown and adjusted drawdown values are included in the attached spreadsheet. The water level measurement in the spreadsheet has been adjusted for precipitation recharge. Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data.

The ratio of adjusted drawdown to the associated pumping rate for the production well ERT-22 were plotted against the log of adjusted time on the attached semi-log plot in Figure A2-7. The ratio of the adjusted residual drawdown (recovery) to the final pumping rate were also plotted against the log of dimensionless time on the same semi-log plot in Figure A2-7. Well bore effects had a significant influence on a portion of the response data. The drawdown response during the latter portion of the drawdown response was used to estimate the transmissivity from the drawdown data. The calculated transmissivity was 100 gpd/ft.

A transmissivity was also calculated from the valid portion of the recovery data from the semi-log plots. The transmissivity determined from the semi-log recovery analysis using the dimensionless time of Summers and Birsoy was 714 gpd/ft. This estimate appears to be reasonable in comparison with the transmissivity from wells having similar specific capacities.

Delayed yield effects were not observed but could have been masked by the variable pumping rate. A storage coefficient could not be determined from the single well response data.

023923



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
SEE INSET "A"
ERT-8
ERT-8A
ERT-7
ERT-7A
REI-6-1
REI-6-2
MR-3
MR-4
ERT-23
ERT-22
REI-11
ERT-21
FG-6
REI-3-2
REI-3-4
REI-3-1
REI-3-3
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0 100 200 400
FEET
POND
SLOUGH
U.S. HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
POND
RIVERDALE SUBDIVISION
P
ABANDONED HARRIS CO. LANDFILL
0 500 1000
FEET
FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-22
8/11/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV.
DRAWN
CHECK.
APPROV.

**ERT** 023926

A RESOURCE ENGINEERING COMPANY

# BORING LOG AND CONSTRUCTION OF ERT-22

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-22
Logged By: Steve Preston
Approved By: Raaj Patel
Drilled By: Gulf Coast Drilling Co Driller's Name: Jim Turner

**DRILLING AND SAMPLING INFORMATION**

Date Started: 12-28-87 Date Completed: 12-28-87
Method: Mud Rotary Total Depth: 53.5 feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch Ø Length: 40.0 feet
Slot Size: 0.010 inch Type: PVC
Casing Dia.: 4-inch Ø Length: 8.0 feet

SURFACE ELEVATION

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown and black silty to clayey sand. (SC) (1.5') | - | ST | 0.0 1.5 | - | - | | 1.9 | | |
| | Light brown silty fine to medium sand. (SM-SP) | - | ST | 3.0 5.0 | - | - | | - | | |
| 5 | (8.0') | | | | | | | | | |
| | Gray to olive gray clayey fine to medium sand. (SC) | - | ST | 8.0 10.0 | - | - | | - | | |
| 10 | (13.0') | | | | | | | | | |
| | Medium dense to dense. light brown silty fine to medium sand. (SM-SP) (14.0') | - | SS | 13.0 15.0 | - | 12/14/16 | | - | | |
| 15 | Dense gray to black fine to medium sand. (SP) | | | | | | | | | |
| | - Medium to coarse grains with occassional gravel from 18.0' | - | SS | 18.0 20.0 | - | 14/15/17 | | - | | |
| 20 | (24.5') | J-4 | SS | 23.5 25.0 | 4.5 | 7/12/16 | | 6.4 | | |
| 25 | Very stiff gray clay, with silt pockets and partings. (CH) (29.5') | - | ST | 28.0 30.0 | 4.5+ | - | | 2.4 | | |
| 30 | Dense olive gray and dark tan silty clay to clayey silt with clay pockets and partings. (CL-ML) (33.0') | | | | | | | | | |
| 35 | Medium dense brown silt, slightly clayey. (ML) | - | ST | 33.0 35.0 | 3.0 | - | | 1.4 | | |
| 40 | | - | SS | 38.5 40.0 | 3.0 | 13/15/17 | | 2.4 | | |
| | - Dense from 44.0' | - | ST | 43.0 45.0 | 4.5+ | - | | 2.4 | | |
| 45 | | | | | | | | | | |
| 50 | (53.0') | - | ST | 48.5 50.0 | 4.5+ | - | | 1.4 | | |
| 55 | Very stiff dark brownish red and light gray clay with silt pockets. (CH) (55.0') | J-5 | ST | 53.0 55.0 | 4.0 | - | | 1.4 | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

# ERT 023927

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

## BORING LOG AND CONSTRUCTION OF ERT-23

Client: ARCO Chemical Company
Project Name: French Limited Site
Project Location: Crosby, Texas
Job No.: 275-23-01 Boring No.: ERT-23
Logged By: Steve Preston
Approved By:
Drilled By: PSI, Inc. Driller's Name: R. Spencer

**DRILLING AND SAMPLING INFORMATION**

Date Started: 12-28-87 Date Completed: 12-28-87
Method: Mud Rotary Total Depth: 60.0 feet

**WELL COMPLETION INFORMATION**

Screen Dia.: 4-inch Ø Length: 40.0 feet
Slot Size: 0.010-inch Type: PVC
Casing Dia.: 4-inch Ø Length: 15.0 feet

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown clay, gravel and glass pieces with trash material. (Fill material) (8.0') | | | | | | | | | |
| | Dark brown sandy clay with gravel (CL) (10.0') | - | ST | 8.5 10.0 | - | - | | - | | |
| 10 | Medium dense light gray fine to medium sand with occassional gravel (SP) | | | | | | | | | |
| | | - | SS | 18.5 20.0 | - | 9/11/2 | | 0.6 | | |
| 20 | (22.0') | | | | | | | | | |
| | Stiff brown clay with occassional gravel (CH) | - | ST | 23.0 25.0 | 3.0 | - | | 1.1 | | |
| | - Olive gray and brown from 29.0' | J-6 | ST | 28.0 30.0 | 3.0 | - | | 0.1 | | |
| 30 | (33.0') | | | | | | | | | |
| | Stiff gray and red silty clay (CL) (34.8') | - | ST | 33.0 35.0 | 2.5 | - | | 1.1 | | |
| 35 | Light gray silty fine sand to fine sand (SM-SP) | | | | | | | | | |
| | | - | ST | 38.5 40.0 | - | - | | - | | |
| | - Gray and red clay layer from 44.0' to 44.2' | - | ST | 43.5 45.0 | - | - | | 3.1 | | |
| | - 1-inch silt layers ~~from 48.0' to 50.0'~~ at 48.0' | - | ST | 48.0 50.0 | — | — | | 12.1 | | |
| | | J-7 | ST | 53.0 55.0 | - | — | | 1.1 | | |
| 55 | - Red clay pockets and partings from 55.0' (57.0') | | | | | | | | | |
| | Very stiff red and gray clay with silt pockets (CH) (60.0') | J-8 | ST | 58.5 60.0 | 3.5 | — | | 1.1 | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

02.39.28

ERT.

A RESOURCE ENGINEERING COMPANY



## SUBSURFACE EXPLORATION — LITHOGRAPHIC LOG OF ERT-7

Client : French LTD.
Project Name : French LTD.
Project Location : Crosby, Texas
Job Number : 275-21 Boring No : ERT-7
Logged By : D. Morgan
Approved By : G. Spradley
Drilled By : Gulf Coast Coring

DRILLING AND SAMPLING INFORMATION
Date Started : 9/28/87 Date Completed : 9/28/87
Method : MR Total Depth : 48'

WELL COMPLETION INFORMATION
Screen Dia : 4" Length : 28.0'
Slot Size : .010 Type : PVC
Casing Dia : 4" Length : 17.7'

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION : ) | SAMPLE NO. | SAMPLE TYPE | RECOVERY (PERCENT) | HNU VALUE | BLOW COUNT | | GRAPHIC LOG | WELL COMPLETION | WATER LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fill, roadbase, gravel, sand, silt | 1 | ST | 80 | - | | | | | |
| 5 | Silty Sand, tan to brown/ gray, fine to medium grained some black sludge material | 2 | SS | 50 | 0.4 | | | | | |
| | | 3 | SS | 50 | 0.2 | | | | | |
| 10 | | 4 | SS | 45 | 0.2 | | | | | |
| | | 5 | SS | 25 | 0.2 | | | | | |
| | | 6 | SS | 50 | 0.6 | | | | | |
| 15 | | 7 | SS | 50 | 0.8 | | | | | |
| | Sand, fine to medium grained, gray, strong odor | 8 | SS | 13 | 0.4 | | | | | |
| | | 9 | SS | NR | | | | | | |
| 20 | | 10 | SS | 17 | - | | | | | |
| | | 11 | SS | 45 | - | | | | | |
| 25 | | 12 | SS | 25 | - | | | | | |
| | | 13 | SS | 25 | - | | | | | |
| | Silty Clay, gray with some red/brown mottles, stiff, with some fine grained sand seams some odor | 14 | SS | 50 | - | | | | | |
| 30 | | 15 | ST | 75 | - | | | | | |
| | | 16 | ST | 50 | - | | | | | |
| 35 | Clayey Silt, light gray, soft, saturated some odor | 17 | ST | 75 | - | | | | | |
| | | 19 | ST | NR | | | | | | |
| | | 20 | ST | 75 | - | | | | | |
| 40 | | 21 | SS | 50 | - | | | | | |
| | | 22 | SS | 65 | - | | | | | |
| 45 | | 23 | ST | 50 | - | | | | | |
| | Silty Clay, light gray, stiff, some tan mottles, no odor | 24 | ST | 84 | - | | | | | |
| 50 | BORING TERMINATED AT 48.0' | | | | | | | | | |
| 55 | | | | | | | | | | |

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

**ERT** 023929

Sheet 1 of 1

A RESOURCE ENGINEERING COMPANY

# BORING LOG AND CONSTRUCTION OF ERT-7A

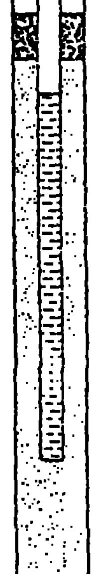
Client ARCO Chemical Company
Project Name French Limited Site
Project Location Crosby, Texas
Job No. 275-23-01 Boring No. ERT-7A
Logged By Steve Preston
Approved By
Drilled By PSI, Inc. Driller's Name R. Spencer

DRILLING AND SAMPLING INFORMATION

Date Started 11-17-87 Date Completed 11-17-87
Method Mud Rotary Total Depth 20.5 feet

WELL COMPLETION INFORMATION

Screen Dia. 4-inch Ø Length 15.0 feet
Slot Size 0.010 inch Type PVC
Casing Dia. 4-inch Length 5.0 feet

| DEPTH IN FEET | DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE ELEVATION | | | | | | | | | |
| 0 | Road fill material (1.5') | | | | | | | | | |
| | Gray medium to fine silty sand | | | | | | | |  | |
| 25 | (25.0') | | | | | | | | | |

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

BORING METHOD

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

PUMPED WELL: ERT-22

CONTROL WELL WATER LEVEL FLUCTUATIONS

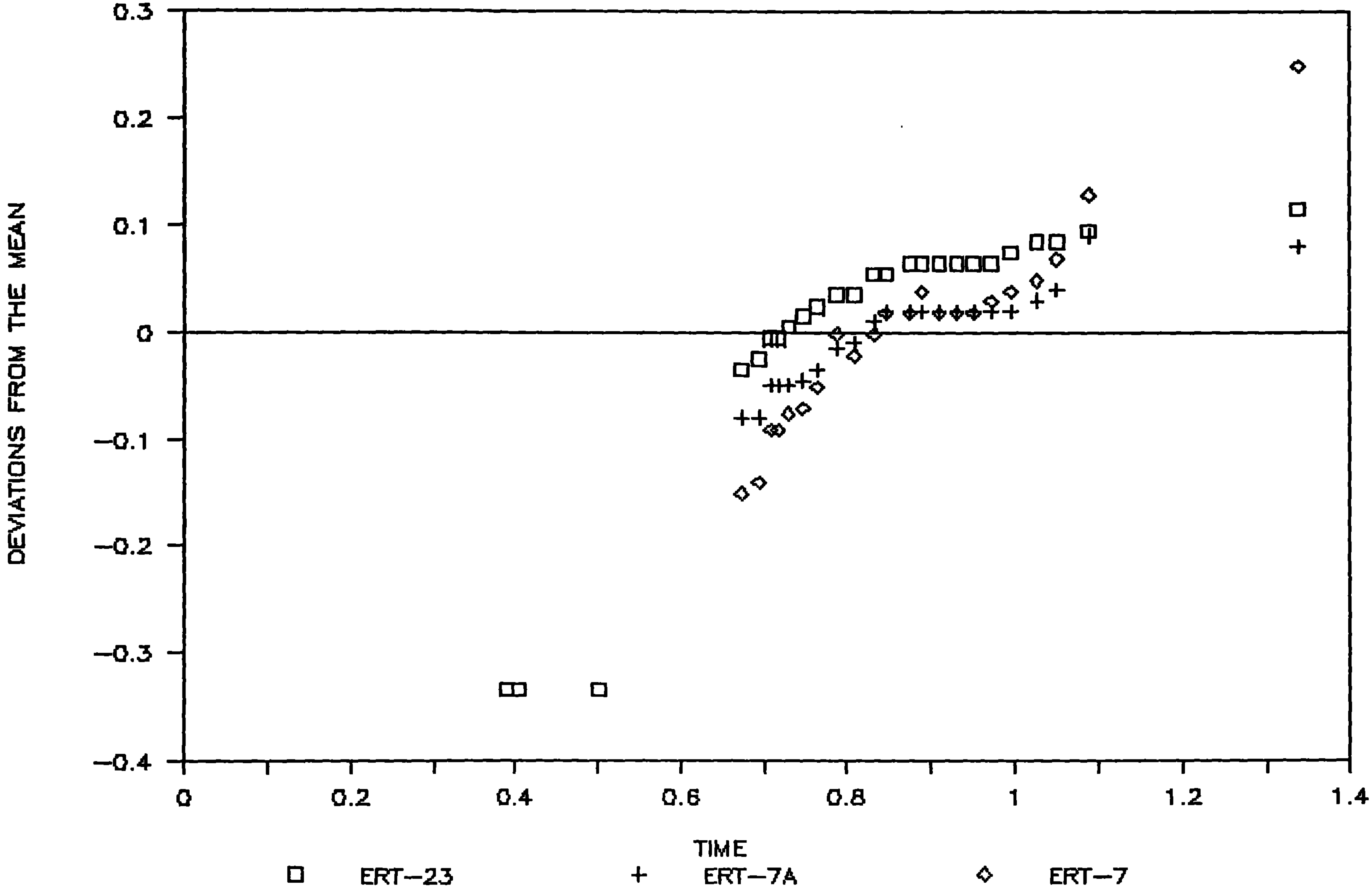
| HOUR | MIN | ERT-23 | MEAN-DEV ERT-23 7.1533 | ERT-7A | MEAN-DEV ERT-7A 5.2702 | ERT-7 | MEAN-DE ERT-7 4.7488 |
|---|---|---|---|---|---|---|---|
| 9 | 19 | 7.45 | -0.30 | | | | |
| 9 | 42 | 7.45 | -0.30 | | | | |
| 12 | 1 | 7.45 | -0.30 | | | | |
| 16 | 7 | 7.15 | 0.00 | | | | |
| 16 | 38 | 7.18 | -0.03 | | | | |
| 16 | 58 | 7.16 | -0.01 | | | | |
| 17 | 12 | 7.16 | -0.01 | | | | |
| 17 | 29 | 7.15 | 0.00 | | | | |
| 17 | 53 | 7.14 | 0.01 | | | | |
| 18 | 18 | 7.13 | 0.02 | | | | |
| 18 | 53 | 7.12 | 0.03 | | | | |
| 19 | 23 | 7.12 | 0.03 | | | | |
| 19 | 56 | 7.10 | 0.05 | | | | |
| 20 | 16 | 7.10 | 0.05 | | | | |
| 20 | 58 | 7.09 | 0.06 | | | | |
| 21 | 18 | 7.09 | 0.06 | | | | |
| 21 | 48 | 7.09 | 0.06 | | | | |
| 22 | 18 | 7.09 | 0.06 | | | | |
| 22 | 48 | 7.09 | 0.06 | | | | |
| 23 | 18 | 7.09 | 0.06 | | | | |
| 23 | 52 | 7.08 | 0.07 | | | | |
| 20 | 36 | 7.07 | 0.08 | | | | |
| 13 | 11 | 7.07 | 0.08 | | | | |
| 14 | 6 | 7.06 | 0.09 | | | | |
| 16 | 1 | | | 5.35 | -0.08 | | |
| 16 | 19 | | | 5.35 | -0.08 | | |
| 16 | 57 | | | 5.32 | -0.05 | | |
| 17 | 11 | | | 5.32 | -0.05 | | |
| 17 | 27 | | | 5.32 | -0.05 | | |
| 17 | 47 | | | 5.32 | -0.04 | | |
| 18 | 13 | | | 5.31 | -0.03 | | |
| 18 | 49 | | | 5.29 | -0.01 | | |
| 19 | 14 | | | 5.28 | -0.01 | | |
| 19 | 51 | | | 5.26 | 0.01 | | |
| 20 | 19 | | | 5.25 | 0.02 | | |
| 20 | 54 | | | 5.25 | 0.02 | | |
| 21 | 15 | | | 5.25 | 0.02 | | |
| 21 | 45 | | | 5.25 | 0.02 | | |
| 22 | 15 | | | 5.25 | 0.02 | | |
| 22 | 45 | | | 5.25 | 0.02 | | |
| 23 | 15 | | | 5.25 | 0.02 | | |
| 23 | 59 | | | 5.25 | 0.02 | | |
| 0 | 28 | | | 5.24 | 0.03 | | |
| 1 | 7 | | | 5.23 | 0.04 | | |
| 14 | 11 | | | 5.18 | 0.09 | | |
| 19 | 58 | | | 5.19 | 0.08 | | |
| 16 | 2 | | | | | 4.90 | -0.15 |

0239.31

| HOUR | MIN | ERT-23 | MEAN-DEV ERT-23 7.1533 | ERT-7A | MEAN-DEV ERT-7A 5.2702 | ERT-7 | MEAN-DE ERT-7 4.7488 |
|---|---|---|---|---|---|---|---|
| 16 | 18 | | | | | 4.89 | -0.14 |
| 16 | 58 | | | | | 4.84 | -0.09 |
| 17 | 10 | | | | | 4.84 | -0.09 |
| 17 | 26 | | | | | 4.83 | -0.08 |
| 17 | 43 | | | | | 4.82 | -0.07 |
| 18 | 14 | | | | | 4.80 | -0.05 |
| 18 | 48 | | | | | 4.75 | -0.00 |
| 19 | 15 | | | | | 4.77 | -0.02 |
| 19 | 50 | | | | | 4.75 | -0.00 |
| 20 | 18 | | | | | 4.73 | 0.02 |
| 20 | 53 | | | | | 4.73 | 0.02 |
| 21 | 14 | | | | | 4.71 | 0.04 |
| 21 | 44 | | | | | 4.73 | 0.02 |
| 22 | 14 | | | | | 4.73 | 0.02 |
| 22 | 44 | | | | | 4.73 | 0.02 |
| 23 | 14 | | | | | 4.72 | 0.03 |
| 23 | 56 | | | | | 4.71 | 0.04 |
| 0 | 30 | | | | | 4.70 | 0.05 |
| 1 | 6 | | | | | 4.68 | 0.07 |
| 14 | 10 | | | | | 4.62 | 0.13 |
| 19 | 56 | | | | | 4.50 | 0.25 |

# AQUIFER PUMP TEST WELL ERT-22

CONTROL WELL WATER LEVEL FLUCTUATIONS



0239 33

STEP DRAWDOWN TEST - WELL ERT-22

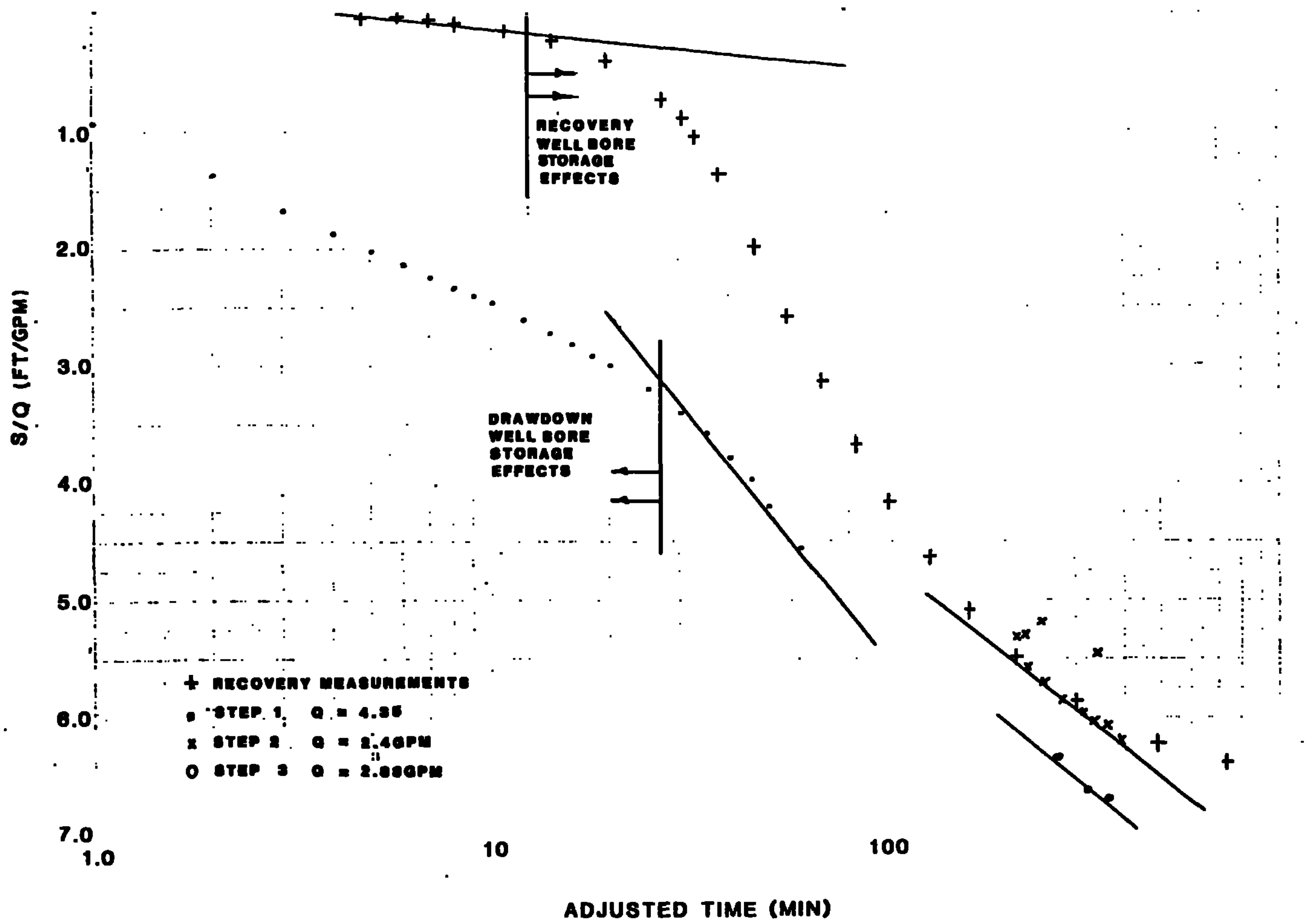
Saturated Thickness 47.02 feet

static water level 2.98 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti min | ADJUSTED TIME min | s/Q ft/gpm | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0.00 | 2.98 | 0.00 | 0.00 | | 0.00 | 0.00 | | |
| 0.50 | 5.63 | 2.65 | 2.58 | | 0.50 | 0.59 | | |
| 1.00 | 7.17 | 4.19 | 4.00 | | 1.00 | 0.92 | | |
| 2.00 | 9.35 | 6.37 | 5.94 | | 2.00 | 1.37 | | |
| 3.00 | 10.91 | 7.93 | 7.26 | | 3.00 | 1.67 | | |
| 4.00 | 11.99 | 9.01 | 8.15 | | 4.00 | 1.87 | | |
| 5.00 | 12.83 | 9.85 | 8.82 | | 5.00 | 2.03 | | |
| 6.00 | 13.49 | 10.51 | 9.34 | | 6.00 | 2.15 | | |
| 7.00 | 14.04 | 11.06 | 9.76 | | 7.00 | 2.24 | | |
| 8.00 | 14.53 | 11.55 | 10.13 | | 8.00 | 2.33 | | |
| 9.00 | 15.00 | 12.02 | 10.48 | | 9.00 | 2.41 | | |
| 10.00 | 15.37 | 12.39 | 10.76 | | 10.00 | 2.47 | | |
| 12.00 | 16.17 | 13.19 | 11.34 | | 12.00 | 2.61 | | |
| 14.00 | 16.87 | 13.89 | 11.84 | | 14.00 | 2.72 | | |
| 16.00 | 17.49 | 14.51 | 12.27 | | 16.00 | 2.82 | | |
| 18.00 | 18.07 | 15.09 | 12.67 | | 18.00 | 2.91 | | |
| 20.00 | 18.66 | 15.68 | 13.06 | | 20.00 | 3.00 | | |
| 25.00 | 20.06 | 17.08 | 13.98 | | 25.00 | 3.21 | | |
| 30.00 | 21.33 | 18.35 | 14.77 | | 30.00 | 3.40 | | |
| 35.00 | 22.77 | 19.79 | 15.62 | | 35.00 | 3.59 | | |
| 40.00 | 24.22 | 21.24 | 16.44 | | 40.00 | 3.78 | | |
| 45.00 | 25.76 | 22.78 | 17.26 | | 45.00 | 3.97 | | |
| 50.00 | 27.77 | 24.79 | 18.25 | | 50.00 | 4.20 | | |
| 60.00 | 31.40 | 28.42 | 19.83 | | 60.00 | 4.56 | | |
| 70.00 | 18.70 | 15.72 | 13.09 | 10.00 | 340.20 | 5.46 | | |
| 80.00 | 17.78 | 14.80 | 12.47 | 20.00 | 246.75 | 5.20 | | |
| 90.00 | 18.10 | 15.12 | 12.69 | 30.00 | 219.74 | 5.29 | | |
| 120.00 | 18.20 | 15.22 | 12.76 | 60.00 | 210.75 | 5.32 | | |
| 150.00 | 19.20 | 16.22 | 13.42 | 90.00 | 227.17 | 5.59 | | |
| 180.00 | 19.59 | 16.61 | 13.67 | 120.00 | 250.23 | 5.70 | | |
| 210.00 | 20.17 | 17.19 | 14.05 | 150.00 | 276.02 | 5.85 | | |
| 248.00 | 20.50 | 17.52 | 14.26 | 188.00 | 310.59 | 5.94 | | |
| 270.00 | 20.84 | 17.86 | 14.47 | 210.00 | 331.16 | 6.03 | | |
| 300.00 | 20.99 | 18.01 | 14.56 | 240.00 | 359.63 | 6.07 | | |
| 330.00 | 21.47 | 18.49 | 14.86 | 270.00 | 388.44 | 6.19 | | |
| 360.00 | 27.76 | 24.78 | 18.25 | 30.00 | 269.19 | 6.34 | | |
| 390.00 | 29.56 | 26.58 | 19.07 | 60.00 | 319.67 | 6.62 | | |
| 419.00 | 30.09 | 27.11 | 19.29 | 89.00 | 359.35 | 6.70 | | |
| 420.50 | 28.11 | 25.13 | 18.41 | 0.50 | 722.57 | 6.39 | 0.50 | 841.00 |
| 420.75 | 27.11 | 24.13 | 17.94 | 0.75 | 482.14 | 6.23 | 0.75 | 561.00 |
| 421.22 | 25.11 | 22.13 | 16.92 | 1.22 | 297.62 | 5.88 | 1.22 | 346.11 |
| 421.73 | 23.11 | 20.13 | 15.82 | 1.73 | 209.39 | 5.49 | 1.73 | 243.35 |
| 422.30 | 21.11 | 18.13 | 14.63 | 2.30 | 158.08 | 5.08 | 2.30 | 183.61 |
| 422.92 | 19.11 | 16.13 | 13.36 | 2.92 | 124.92 | 4.64 | 2.92 | 144.98 |
| 423.63 | 17.11 | 14.13 | 12.01 | 3.63 | 100.55 | 4.17 | 3.63 | 116.61 |

023934

| TIME-t<br>min | DEPTH<br>ft | DRAWDOWN<br>ft | ADJUSTED DRAWDOWN<br>ft | t-Ti<br>min | ADJUSTED TIME<br>min | s/Q<br>ft/gpm | RECOVERY TIME-t'<br>min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 424.45 | 15.11 | 12.13 | 10.56 | 4.45 | 82.32 | 3.67 | 4.45 | 95.38 |
| 425.40 | 13.11 | 10.13 | 9.04 | 5.40 | 68.06 | 3.14 | 5.40 | 78.78 |
| 426.55 | 11.11 | 8.13 | 7.43 | 6.55 | 56.33 | 2.58 | 6.55 | 65.12 |
| 428.08 | 9.11 | 6.13 | 5.73 | 8.08 | 45.89 | 1.99 | 8.08 | 52.96 |
| 429.90 | 7.11 | 4.13 | 3.95 | 9.90 | 37.70 | 1.37 | 9.90 | 43.42 |
| 431.28 | 6.11 | 3.13 | 3.03 | 11.28 | 33.23 | 1.05 | 11.28 | 38.22 |
| 432.38 | 5.61 | 2.63 | 2.56 | 12.38 | 30.39 | 0.89 | 12.38 | 34.92 |
| 433.90 | 5.11 | 2.13 | 2.08 | 13.90 | 27.21 | 0.72 | 13.90 | 31.22 |
| 439.57 | 4.11 | 1.13 | 1.12 | 19.57 | 19.68 | 0.39 | 19.57 | 22.46 |
| 447.93 | 3.61 | 0.63 | 0.63 | 27.93 | 14.15 | 0.22 | 27.93 | 16.04 |
| 457.99 | 3.38 | 0.40 | 0.40 | 37.99 | 10.72 | 0.14 | 37.99 | 12.05 |
| 472.93 | 3.19 | 0.21 | 0.21 | 52.93 | 8.02 | 0.07 | 52.93 | 8.93 |
| 482.22 | 3.13 | 0.15 | 0.14 | 62.22 | 7.00 | 0.05 | 62.22 | 7.75 |
| 498.25 | 3.03 | 0.05 | 0.05 | 78.25 | 5.80 | 0.02 | 78.25 | 6.37 |
| 522.55 | 3.04 | 0.06 | 0.06 | 102.55 | 4.69 | 0.02 | 102.55 | 5.10 |
| 556.20 | 2.86 | -0.12 | -0.12 | 136.20 | 3.80 | -0.04 | 136.20 | 4.08 |
| 770.00 | 2.65 | -0.33 | -0.34 | 350.00 | 2.12 | -0.12 | 350.00 | 2.20 |
| 908.00 | 2.61 | -0.37 | -0.37 | 488.00 | 1.81 | -0.13 | 488.00 | 1.86 |




PUMPED WELL ERT-22
RECOVERY ANALYSIS

$$T = \frac{264}{(S/Q)} \text{ gpd/ft}$$

$$T = \frac{264}{.37} = 714 \text{ gpd/ft}$$

PUMPED WELL ERT-22
DRAWDOWN ANALYSIS

$$T = \frac{264}{(S/Q)} \text{ gpd/ft}$$

$$T = \frac{264}{2.65} = 100 \text{ gpd/ft}$$

B-294

**FRENCH LIMITED PROJECT**
CROSBY, TEXAS

**FIGURE A2-12**
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL: ERT-22
OBSERVATION WELL: ERT-22
DATE(S): AUG.11, 1988

| PROJECT No. 26 | DATE 9/12 | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

023935

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 12, 1988

PUMPED WELL: ERT-29

TOTAL DEPTH: 50 FEET

SCREENED INTERVAL: 20 FT. TO 50 FT. CASING DIAMETER: 4 IN.

OBSERVATION WELLS: ERT-28 and ERT-30

CONTROL WELLS: ERT-23

BACKGROUND AND DESCRIPTION OF TEST:

The test of ERT-28 was included to provide information about aquifer characteristics between the French Limited Lagoon and the Riverdale Subdivision. The preliminary pumping test program indicated that the well had been pumped at 11 gpm for almost 20 minutes. Based on these results, personnel performing the test attempted to pump the well at four gpm on August 11. The water level was drawn down to the pump intake after just 6.5 minutes and the test was terminated. Measurements had not yet been taken with a bucket and stop watch, so it is possible that the actual pumping rate may have been greater than four gpm. Also in subsequent discussions with Norm Nielsen of Applied Hydrology Associates, it was discovered that during the preliminary pump test which was conducted during well purging prior to sampling, the well was pumped without a valve control and the 11 gpm rate was based on one bucket and stop watch measurement. Thus, the flow rate estimates for the preliminary pump test may be in error.

The test was re-run on August 12, with the flow rate set to and maintained at about 0.75 gpm. Subsequent measurements with a bucket and stop watch indicated a pumping rate of 0.66 gpm. At these low pumping rates, it was concluded that observation wells ERT-28 and ERT-30 located over 150 feet from the pumped well would not experience any drawdown due to pumping during an eight-hour test. Nevertheless, these two wells and control well ERT-23 were monitored for water levels about every one-half hour.

After one hour of pumping at 0.66 gpm the drawdown was less than four feet and had appeared to level out. The personnel performing the test decided to increase the pumping rate to about 1.1 gpm since the variable rate test would help discriminate the drawdown due to formations loss from that due to well inefficiency. At 106.3 minutes into the test, the pump stopped for two minutes and the generator was re-fueled. Even though the valves were not adjusted, the pumping rate after re-fueling dropped to about 0.78 gpm. The flow was maintained at this rate for about 102 minutes. Then at 210 minutes into the test, the rate was stepped up to about 1.89 gpm. After pumping at this rate for about 10 minutes, the rate started to drop but was not adjusted immediately because the Rotometer measured rates only up to one gpm. The pumping rate from averaged about 1.53 gpm for the next 30 minutes. The pump rate was increased to about 4.2 gpm for the last ten minutes and recovery measurements were taken for about two hours following the test. Water levels in the pumping well had recovered to within 0.11 feet of the original static water level. Field measurements are attached.

Water produced from the test was pumped into 55-gallon drums during the test. The contents of the 55-gallon drums were emptied into the French Limited Lagoon following completion of the test.

INTERPRETATION:

The control wells ERT-30, ERT-28 and ERT-23 showed no obvious response due to pumping well ERT-29. The water levels in all three wells rose near the latter portion of the pumping period but started dropping shortly before the pump was shut off. The decline continued into the recovery period. The total water level fluctuation in the control wells was less than 0.05 feet, as shown in Figure 1. These changes were small and appeared to follow a diurnal pattern similar to that observed for the control wells during the ERT-10 well test.

Drawdown values determined from water level measurements in the production well ERT-29 were adjusted using Jacob's (1963) correction for water table conditions. Jacob's correction is:

$$s' = s - s^2/2Ho$$

where: $s'$ = adjusted drawdown
$s$ = drawdown and
$Ho$ = initial saturated thickness

Drawdown and adjusted drawdown values are included in the attached data sheet. Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data.

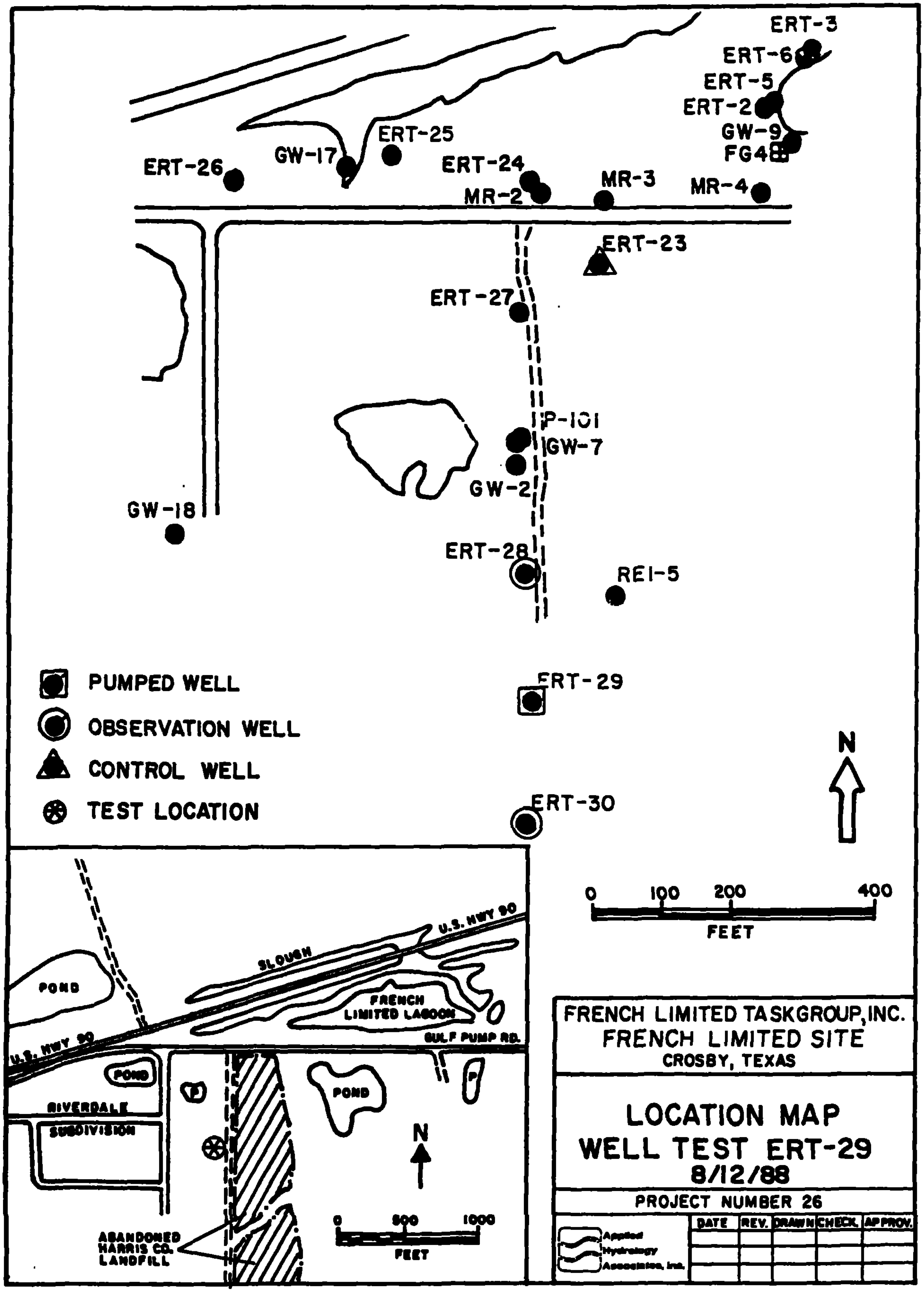
The ratio of adjusted drawdown to the associated pumping rate for the production well ERT-29 was plotted against the log of adjusted time on the attached semi-log plot in Figure A-8. The ratio of the adjusted residual drawdown (recovery) to the final pumping rate was also plotted against the log of dimensionless time on the same semi-log plot in Figure A-8. Well bore effects had a significant influence on a large portion of the response data. The drawdown response during the latter portion of the test was too erratic to allow for an estimation of the transmissivity from the drawdown data. The reason for the erratic response is not entirely clear. It appears to be the result of fluctuations in the pumping rate, although the bucket-and-stop-watch measurements did not indicate a significant change in the pumping rate.

A transmissivity was calculated from the valid portion of the recovery data from the semi-log plots. Unfortunately there were only three data points in the recovery plots that were determined to be outside the range of well bore storage effects. The transmissivity determined from the semi-log recovery analysis using the dimensionless time of Summers and Birsoy was 1467 gpd/ft. This estimate appears to have considerable error since it does not correspond with the low specific capacity of the well. The large error is probably because it was derived from three data points near the final stages of recovery. Measurement errors and water level response to influences other than pumping would be relatively significant in the latter stages of recovery where the residual drawdown is less than 0.1 feet. A transmissivity of 1221 gpd/ft was also calculated from the valid portion of the recovery data using the Theis (1935) recovery method in Figure A2-9. This estimate may also have considerable error for the same reasons described previously.

Delayed yield effects were not observed but could have been masked by the variable pumping rate. A storage coefficient could not be determined from the single well response data.

The transmissivity estimate from the recovery analyses seems to be high in comparison with the results from the more productive wells such as ERT-22, ERT-21 and ERT-7. If an accurate estimate of transmissivity is needed in the region around the well ERT-29, then a new test should be performed. The pump test should be run long enough to produce a response in wells ERT-28 and ERT-30 or an observation well should be installed closer to the pumped well.

02.39 9



ERT-3
ERT-6
ERT-5
ERT-2
GW-9
FG4
ERT-25
GW-17
ERT-26
ERT-24
MR-3
MR-2
MR-4
ERT-23
ERT-27
P-101
GW-7
GW-2
GW-18
ERT-28
REI-5
ERT-29
ERT-30
PUMPED WELL
OBSERVATION WELL
CONTROL WELL
TEST LOCATION
N
0
100
200
400
FEET
POND
SLOUGH
U.S. HWY 90
FRENCH LIMITED LAGOON
GULF PUMP RD.
U.S. HWY 90
POND
RIVERDALE
SUBDIVISION
POND
N
ABANDONED HARRIS CO. LANDFILL
0
500
1000
FEET
FRENCH LIMITED TASKGROUP, INC.
FRENCH LIMITED SITE
CROSBY, TEXAS
LOCATION MAP
WELL TEST ERT-29
8/12/88
PROJECT NUMBER 26
Applied Hydrology Associates, Inc.
DATE
REV.
DRAWN
CHECK.
APPROV.

ERD

A RESOURCE ENGINEERING COMPANY

# BORING LOG AND CONSTRUCTION OF ERT-29

Client [illegible]
Project Name [illegible]
Project Location [illegible], TX
Job No. [illegible]  Boring No. ERT-29
Logged By [illegible]
Approved By
Drilled By Southwestern Labs  Driller's Name Les Welch

DRILLING AND SAMPLING INFORMATION
Date Started 3-26-88  Date Completed 3-27-88
Method Mud Rotary  Total Depth 63 ft

WELL COMPLETION INFORMATION
Screen Dia. 4 in  Length 50 ft
Slot Size 0.010 in  Type PVC
Casing Dia. 4 in  Length ~~[illegible]~~ 7 ft.

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Light brown sand and gravel fill (1.0') | J-1 | SS | 1.0 | | 8-3-2 | | [illegible] | | |
| | Firm dark gray clay with sand partings (CH). (4.0') | | | | | | | | | |
| 5 | Dense dark gray silty fine sand (SM). | J-2 | SS | 5.0 | | 5-9-11 | | 0 | | |
| 10 | -8.5' light gray and brown, with occasional gravel and shell fragments | J-3 | SS | 10.0 | | 3-5-5 | | 0 | | |
| 15 | | J-4 | SS | 15.0 | | 5-14-19 | | 0 | | |
| | (18.0') | | | | | | | | | |
| 20 | Loose to medium dense light gray and brown sandy silt, with occasional medium to coarse sand. | J-5 | SS | 20.0 | | 9-11-10 | | 0 | | |
| | -23.0' clay pockets and partings, occasional rock fragments | | | | | | | | | |
| 25 | | J-6 | SS | 25.0 | | 3-3-4 | | 0 | | |
| | (28.0') | | | | | | | | | |
| 30 | Dense dark tan and light brown silty fine sand. (31.0') | J-7 | SS | 30.0 | | 8-21-21 | | 0 | | |
| | Very stiff dark brown and light gray clay, with silty sand pockets and slickensides (CH). | | | | | | | | | |
| 35 | | J-8 | ST | 35.0 | 4.0 | | | 0 | | |
| 40 | | J-9 | ST | 40.0 | 4.0 | | | 0 | | |
| | (43.0') | | | | | | | | | |
| 45 | Very dense light gray clayey silt, with sand pockets (ML). | J-10 | ST | 45.0 | 2.5 | | | 0 | | |
| 50 | | J-11 | SS | 50.0 | | 17-28-26 | | 0 | | |
| 55 | -54.0' light tan | J-12 | ST | 55.0 | 3.0 | | | 0 | | |
| | (58.0') Very stiff, reddish brown, dark tan and gray clay, some yellow and gray color bands and sandy silt partings (CH). | | | | | | | | | |
| 60 | | J-13 | ST | 60.0 | 4.0 | | | 0 | | |

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

BORING METHOD
HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

ERI RESOURCE ENGINEERING COMPANY

# BORING LOG AND CONSTRUCTION OF ERT-28

Client: ARCO CHEMICAL
Project Name: [illegible]
Project Location: [illegible]
Job No. 95CC-C78-001 Boring No. ERT-28
Logged By: J. GREEN
Approved By:
Drilled By: SOUTHWESTERN LABS Driller's Name: TONY SANDOVAL

**DRILLING AND SAMPLING INFORMATION**
Date Started: 3-27-88 Date Completed: 3-27-88
Method: Mud Rotary Total Depth: 68 ft

**WELL COMPLETION INFORMATION**
Screen Dia. 4 in Length: 55 ft
Slot Size: 0.010 in Type: PVC
Casing Dia. 4 in Length: ~~[illegible]~~ 8 ft

| Depth in Feet | Description (Surface Elevation) | Sample No. | Sample Type | Sample Depth (in feet) | Pocket Penetrometer (Tons/Ft.²) | Blow Counts | % Recovery | HNU Value (in units) | Well Completion | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Medium dense dark brown clay with shell and rock fill. | J-1 | SS | 1.0 | | 3-1-17 | | 0 | | |
| 4.5 | (4.5') | | | | | | | | | |
| 5 | Medium dense light gray fine sand (SW) | J-2 | SS | 5.0 | | 4-6-5 | | 0 | | |
| 10 | | J-3 | SS | 10.0 | | 5-17-10 | | 0 | | |
| | -13.5' dark brown clay seam 2" thick | | | | | | | | | |
| 15 | | J-4 | SS | 15.0 | | 10-11-14 | | 0 | | |
| | -19.0' light gray stiff clay seam 1" thick | | | | | | | | | |
| 20 | | J-5 | SS | 20.0 | | 3-4-5 | | 0 | | |
| 24 | (24.0') | | | | | | | | | |
| 25 | Medium dense dark gray clayey sand (SC) | J-6 | SS | 25.0 | | 2-4-12 | | [illegible] | | |
| 29 | (29.0') | | | | | | | | | |
| 30 | Stiff light tan and red clay (CH) | J-7 | SS | [illegible] | | [illegible]-9-9 | | [illegible] | | |
| 35 | | J-8 | SS | [illegible] | | 5-10-13 | | [illegible] | | |
| 39.5 | (39.5') | | | | | | | | | |
| 40 | Very dense light brown and light gray clayey sand, some silt (SC). | J-9 | SS | 40.0 | | 6-10-25 | | [illegible] | | |
| 45 | | J-10 | SS | 45.0 | | 15-30-47 | | [illegible] | | |
| 50 | | J-11 | SS | 50. | | 6-14-17 | | 0 | | |
| 55 | | J-12 | SS | 55.0 | | 14-23-32 | | 0 | | |
| 60 | | | | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

**ERT** 023095

A RESOURCE ENGINEERING COMPANY

Sheet 1 of 1

# BORING LOG AND CONSTRUCTION OF ERT-30

Client [illegible]
Project Name [illegible]
Project Location Crosby, TX
Job No. [illegible]  Boring No. ERT-30
Logged By C. Teller
Approved By
Drilled By Southwestern Labs  Driller's Name L. Welch

DRILLING AND SAMPLING INFORMATION
Date Started 3-23-88  Date Completed 3-25-87
Method Mud Rotary  Total Depth 58 ft

WELL COMPLETION INFORMATION
Screen Dia. 4 in  Length 45 ft
Slot Size 0.010 in  Type pvc
Casing Dia. 4 in  Length 8 ft

| DEPTH IN FEET | DESCRIPTION (SURFACE ELEVATION) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dense brown and black fill: shells, asphalt. (1.0') | J-1 | SS | 2.0 | | | | (0.2) 0.2 | | |
| | Loose tan fine sand, well sorted. (SW) | | | | | | | | | |
| 5 | | J-2 | SS | 5.0 | | 7-7-8 | | 0.2 | | |
| 10 | -10' fine to medium, some shell fragments | J-3 | SS | 10.0 | | 5-7-8 | | 0.2 | | |
| 15 | -16' no shell fragments, medium dense | J-4 | SS | 16.0 | | 7-12-19 | | 0.2 | | |
| 20 | -19' sandy clay layer (½ ft), fine sand below. | J-5 | SS | 20.0 | | 5-13-15 | | 0.2 | | |
| 25 | -25' fine to medium, one small (½ in) clay layer near bottom of sample, one rock fragment. (29.0') | J-6 | SS | 25.0 | | 18-27-23 | | 0.2 | | |
| 30 | Very stiff, brown with occasional gray patches, silty clay, little sand. One rock fragment at top of sample. (CL) | J-7 | SS | 30.0 | 3.25 | 5-5-10 | | 0.2 | | |
| 35 | -35' occasional black carbonaceous fragments and white to gray carbonate rock fragments. | J-8 | SS | 35.0 | 4.5 | 10-16-18 | | 0.2 | | |
| 40 | -40' gray, no carbonate fragments. | J-9 | SS | 40.0 | 3.25 | 7-8-14 | | 0.2 | | |
| 45 | (48.5') | J-10 | SS | 45.0 | 3.25 | 12-27-41 | | 0.2 | | |
| 50 | Dense light gray fine sandy silt (SM) (54.0') | J-11 | SS | 50.0 | | 24-34-41 | | 0.2 | | |
| 55 | Stiff reddish brown silty clay. Some yellow and gray patches and laminations. Fine sand and silt partings, occasional carbonate fragments (CL) | J-12 | SS | 55.0 | 3.75 | 11-13-15 | | 0.2 | | |
| | (58.0') | J-13 | ST | 57.0 | 4.25 | | | 0.2 | | |
| 60 | Boring terminated at 58 ft. | | | | | | | | | |

**SAMPLER TYPE**
SS - DRIVEN SPLIT SPOON  CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE  RC - ROCK CORE

**BORING METHOD**
HSA - HOLLOW STEM AUGERS  DC - DRIVING CASING
CFA - CONTINUOUS FLIGHT AUGERS  MD - MUD DRILLING

**ERT** 023943

A RESOURCE ENGINEERING COMPANY



# BORING LOG AND CONSTRUCTION OF ERT-23

| | |
|---|---|
| Client | ARCO Chemical Company |
| Project Name | French Limited Site |
| Project Location | Crosby, Texas |
| Job No. | 275-23-01 |
| Boring No. | ERT-23 |
| Logged By | Steve Preston |
| Approved By | |
| Drilled By | PSI, Inc. |
| Driller's Name | R. Spencer |

**DRILLING AND SAMPLING INFORMATION**

| | | | |
|---|---|---|---|
| Date Started | 12-28-87 | Date Completed | 12-28-87 |
| Method | Mud Rotary | Total Depth | 60.0 feet |

**WELL COMPLETION INFORMATION**

| | | | |
|---|---|---|---|
| Screen Dia. | 4-inch Ø | Length | 40.0 feet |
| Slot Size | 0.010-inch | Type | PVC |
| Casing Dia. | 4-inch Ø | Length | 15.0 feet |

| DEPTH IN FEET | DESCRIPTION / SURFACE ELEVATION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (in feet) | POCKET PENETROMETER (Tons/Ft.2) | BLOW COUNTS | % RECOVERY | HNU VALUE (in units) | WELL COMPLETION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Dark brown clay, gravel and glass pieces with trash material. (Fill material) | | | | | | | | | |
| 5 | (8.0') | | | | | | | | | |
| | Dark brown sandy clay with gravel (CL) (10.0') | - | ST | 8.5 10.0 | - | - | | - | | |
| 10 | Medium dense light gray fine to medium sand with occassional gravel (SP) | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | - | SS | 18.5 20.0 | - | 9/11/2 | | 0.6 | | |
| | (22.0') | | | | | | | | | |
| | Stiff brown clay with occassional gravel (CH) | - | ST | 23.0 25.0 | 3.0 | - | | 1.1 | | |
| 25 | - Olive gray and brown from 29.0' | J-6 | ST | 28.0 30.0 | 3.0 | - | | 0.1 | | |
| 30 | (33.0') | | | | | | | | | |
| | Stiff gray and red silty clay (CL) (34.8') | - | ST | 33.0 35.0 | 2.5 | - | | 1.1 | | |
| 35 | Light gray silty fine sand to fine sand (SM-SP) | | | | | | | | | |
| 40 | | - | ST | 38.5 40.0 | - | - | | - | | |
| | - Gray and red clay layer from 44.0' to 44.2' | - | ST | 43.5 45.0 | - | - | | 3.1 | | |
| 45 | - 1-inch silt layers ~~from 48.0' to 50.0'~~ at 48.0' | | | | | | | | | |
| 50 | | - | ST | 48.0 50.0 | - | - | | 12.1 | | |
| 55 | - Red clay pockets and partings from 53.0' | J-7 | ST | 53.0 55.0 | - | - | | 1.1 | | |
| | (57.0') | | | | | | | | | |
| | Very stiff red and gray clay with silt pockets (CH) (60.0') | J-8 | ST | 58.5 60.0 | 3.5 | - | | 1.1 | | |

**SAMPLER TYPE**

SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER

ST - PRESSED SHELBY TUBE RC - ROCK CORE

**BORING METHOD**

HSA - HOLLOW STEM AUGERS DC - DRIVING CASING

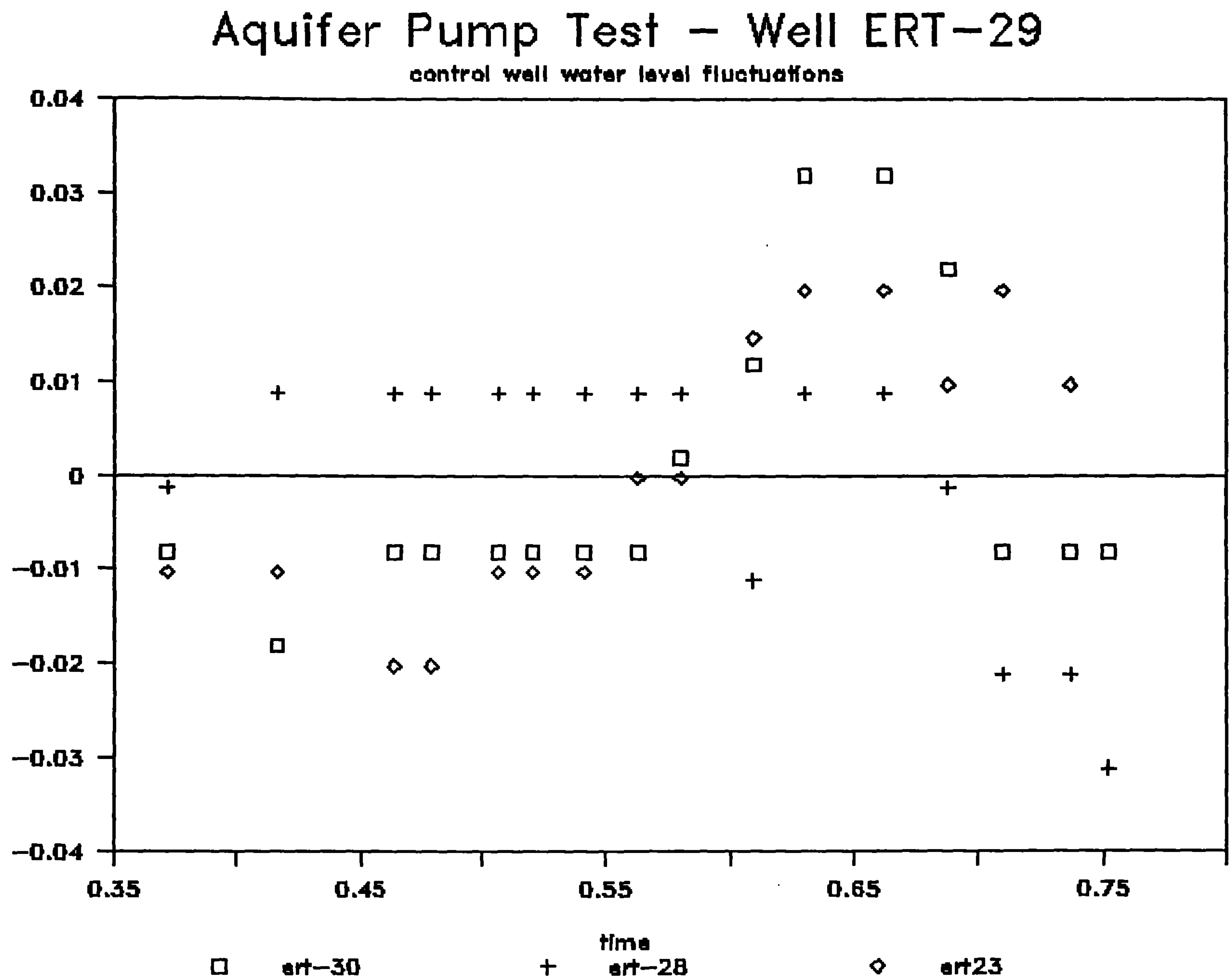
CFA - CONTINUOUS FLIGHT AUGERS MD - MUD DRILLING

023944

PUMPED WELL: ERT-29

CONTROL WELL WATER LEVEL FLUCTUATIONS

| HOUR | min | ERT-30 | MEAN-DEV ERT-30 14.42 | ERT-28 | MEAN-DEV ERT-30 13.82 | ERT-23 | MEAN-DEV ERT-30 7.039 |
|---|---|---|---|---|---|---|---|
| 8 | 55 | 14.43 | -0.01 | | | | |
| 9 | 59 | 14.44 | -0.02 | | | | |
| 11 | 9 | 14.43 | -0.01 | | | | |
| 11 | 30 | 14.43 | -0.01 | | | | |
| 12 | 9 | 14.43 | -0.01 | | | | |
| 12 | 29 | 14.43 | -0.01 | | | | |
| 12 | 59 | 14.43 | -0.01 | | | | |
| 13 | 30 | 14.43 | -0.01 | | | | |
| 13 | 55 | 14.42 | 0.00 | | | | |
| 14 | 37 | 14.41 | 0.01 | | | | |
| 15 | 7 | 14.39 | 0.03 | | | | |
| 15 | 53 | 14.39 | 0.03 | | | | |
| 16 | 30 | 14.40 | 0.02 | | | | |
| 17 | 2 | 14.43 | -0.01 | | | | |
| 17 | 41 | 14.43 | -0.01 | | | | |
| 18 | 3 | 14.43 | -0.01 | | | | |
| 8 | 59 | | | 13.83 | -0.00 | | |
| 9 | 55 | | | 13.82 | 0.01 | | |
| 11 | 5 | | | 13.82 | 0.01 | | |
| 11 | 34 | | | 13.82 | 0.01 | | |
| 12 | 5 | | | 13.82 | 0.01 | | |
| 12 | 31 | | | 13.82 | 0.01 | | |
| 13 | 2 | | | 13.82 | 0.01 | | |
| 13 | 27 | | | 13.82 | 0.01 | | |
| 13 | 58 | | | 13.82 | 0.01 | | |
| 14 | 34 | | | 13.84 | -0.01 | | |
| 15 | 0 | | | 13.82 | 0.01 | | |
| 15 | 46 | | | 13.82 | 0.01 | | |
| 16 | 27 | | | 13.83 | -0.00 | | |
| 17 | 0 | | | 13.85 | -0.02 | | |
| 17 | 37 | | | 13.85 | -0.02 | | |
| 18 | 6 | | | 13.86 | -0.03 | | |
| 9 | 6 | | | | | 7.05 | -0.01 |
| 11 | 2 | | | | | 7.05 | -0.01 |
| 11 | 39 | | | | | 7.06 | -0.02 |
| 12 | 1 | | | | | 7.06 | -0.02 |
| 12 | 35 | | | | | 7.05 | -0.01 |
| 13 | 5 | | | | | 7.05 | -0.01 |
| 13 | 25 | | | | | 7.05 | -0.01 |
| 14 | 1 | | | | | 7.04 | -0.00 |
| 14 | 30 | | | | | 7.04 | -0.00 |
| 15 | 3 | | | | | 7.03 | 0.01 |
| 15 | 43 | | | | | 7.02 | 0.02 |
| 16 | 24 | | | | | 7.02 | 0.02 |
| 16 | 57 | | | | | 7.03 | 0.01 |
| 17 | 34 | | | | | 7.02 | 0.02 |
| 18 | 10 | | | | | 7.03 | 0.01 |



Aquifer Pump Test - Well ERT-29
control well water level fluctuations
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
deviations from the mean
0.35
0.45
0.55
0.65
0.75
time
ert-30
ert-28
ert23


B-304

023945

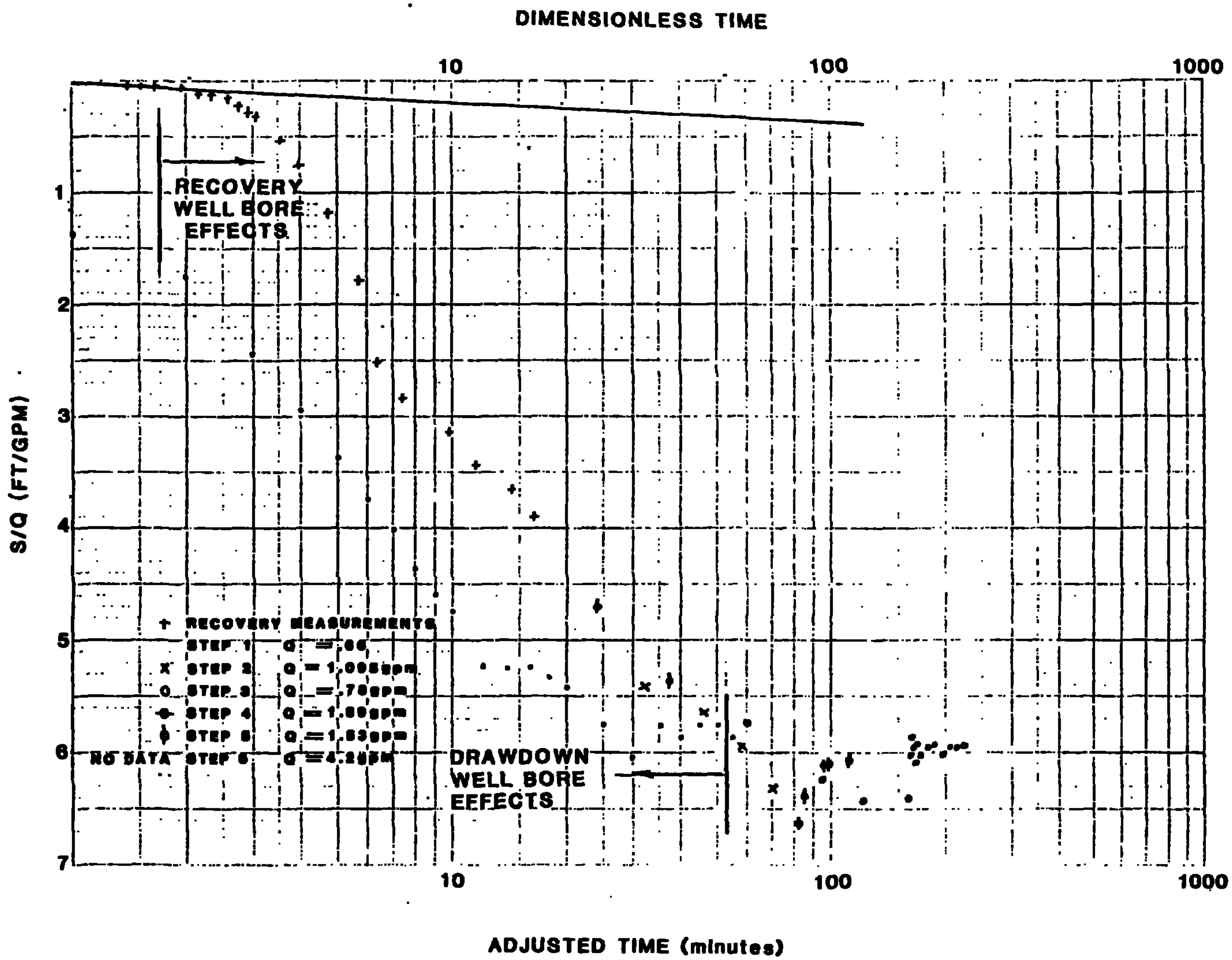
023915

STEP DRAWDOWN TEST - WELL ERT-29

Saturated Thickness 43.34 feet

static water level 11.66 feet

| TIME-t min | DEPTH ft | DRAWDOWN ft | ADJUSTED DRAWDOWN ft | t-Ti min | Adjusted time min | s/Q | RECOVERY TIME-t' min | t/t' |
|---|---|---|---|---|---|---|---|---|
| 0 | 11.66 | 0 | 0.00 | | 0.00 | 0.00 | | |
| 0.5 | 12.37 | 0.71 | 0.70 | | 0.50 | 1.07 | | |
| 1 | 12.58 | 0.92 | 0.91 | | 1.00 | 1.38 | | |
| 2 | 12.84 | 1.18 | 1.16 | | 2.00 | 1.76 | | |
| 3 | 13.3 | 1.64 | 1.61 | | 3.00 | 2.44 | | |
| 4 | 13.66 | 2 | 1.95 | | 4.00 | 2.96 | | |
| 5 | 13.95 | 2.29 | 2.23 | | 5.00 | 3.38 | | |
| 6 | 14.21 | 2.55 | 2.47 | | 6.00 | 3.75 | | |
| 7 | 14.4 | 2.74 | 2.65 | | 7.00 | 4.02 | | |
| 8 | 14.65 | 2.99 | 2.89 | | 8.00 | 4.37 | | |
| 9 | 14.81 | 3.15 | 3.04 | | 9.00 | 4.60 | | |
| 10 | 14.91 | 3.25 | 3.13 | | 10.00 | 4.74 | | |
| 12 | 15.26 | 3.6 | 3.45 | | 12.00 | 5.23 | | |
| 14 | 15.28 | 3.62 | 3.47 | | 14.00 | 5.26 | | |
| 16 | 15.27 | 3.61 | 3.46 | | 16.00 | 5.24 | | |
| 18 | 15.32 | 3.66 | 3.51 | | 18.00 | 5.31 | | |
| 20 | 15.39 | 3.73 | 3.57 | | 20.00 | 5.41 | | |
| 25 | 15.63 | 3.97 | 3.79 | | 25.00 | 5.74 | | |
| 30 | 15.87 | 4.21 | 4.01 | | 30.00 | 6.07 | | |
| 35 | 15.65 | 3.99 | 3.81 | | 35.00 | 5.77 | | |
| 40 | 15.72 | 4.06 | 3.87 | | 40.00 | 5.86 | | |
| 45 | 15.64 | 3.98 | 3.80 | | 45.00 | 5.75 | | |
| 50 | 15.63 | 3.97 | 3.79 | | 50.00 | 5.74 | | |
| 55 | 15.73 | 4.07 | 3.88 | | 55.00 | 5.88 | | |
| 60 | 15.62 | 3.96 | 3.78 | | 60.00 | 5.73 | | |
| 70 | 18.05 | 6.39 | 5.92 | 10 | 32.31 | 5.41 | | |
| 80 | 18.36 | 6.7 | 6.18 | 20 | 46.12 | 5.65 | | |
| 90 | 18.75 | 7.09 | 6.51 | 30 | 58.17 | 5.95 | | |
| 100 | 19.23 | 7.57 | 6.91 | 40 | 69.49 | 6.31 | | |
| 108.3 | 16.72 | 5.06 | 4.76 | 2.017 | 38.97 | 4.35 | | |
| 109.3 | 16.9 | 5.24 | 4.92 | 1.017 | 95.06 | 6.23 | | |
| 110 | 17.08 | 5.42 | 5.08 | 1.7 | 121.30 | 6.43 | | |
| 115 | 17.05 | 5.39 | 5.05 | 6.7 | 159.86 | 6.40 | | |
| 120 | 16.72 | 5.06 | 4.76 | 11.7 | 161.72 | 6.03 | | |
| 125 | 16.58 | 4.92 | 4.64 | 16.7 | 162.16 | 5.87 | | |
| 130 | 16.65 | 4.99 | 4.70 | 21.7 | 163.31 | 5.95 | | |
| 135 | 16.63 | 4.97 | 4.69 | 26.7 | 165.20 | 5.93 | | |
| 140 | 16.77 | 5.11 | 4.81 | 31.7 | 167.69 | 6.09 | | |
| 150 | 16.7 | 5.04 | 4.75 | 41.7 | 173.93 | 6.01 | | |
| 160 | 16.65 | 4.99 | 4.70 | 51.7 | 181.26 | 5.95 | | |
| 170 | 16.63 | 4.97 | 4.69 | 61.7 | 189.27 | 5.93 | | |
| 180 | 16.7 | 5.04 | 4.75 | 71.7 | 197.74 | 6.01 | | |
| 190 | 16.65 | 4.99 | 4.70 | 81.7 | 206.52 | 5.95 | | |
| 200 | 16.64 | 4.98 | 4.69 | 91.7 | 215.52 | 5.94 | | |
| 210 | 16.63 | 4.97 | 4.69 | 101.7 | 224.70 | 5.93 | | |




PUMPED WELL ERT-29
RECOVERY ANALYSIS

$T = \frac{264}{\Delta(S/Q)}$ gpd/ft

$T = \frac{264}{.18} = 1467$ gpd/ft

B-307

**FRENCH LIMITED PROJECT**
CROSBY, TEXAS

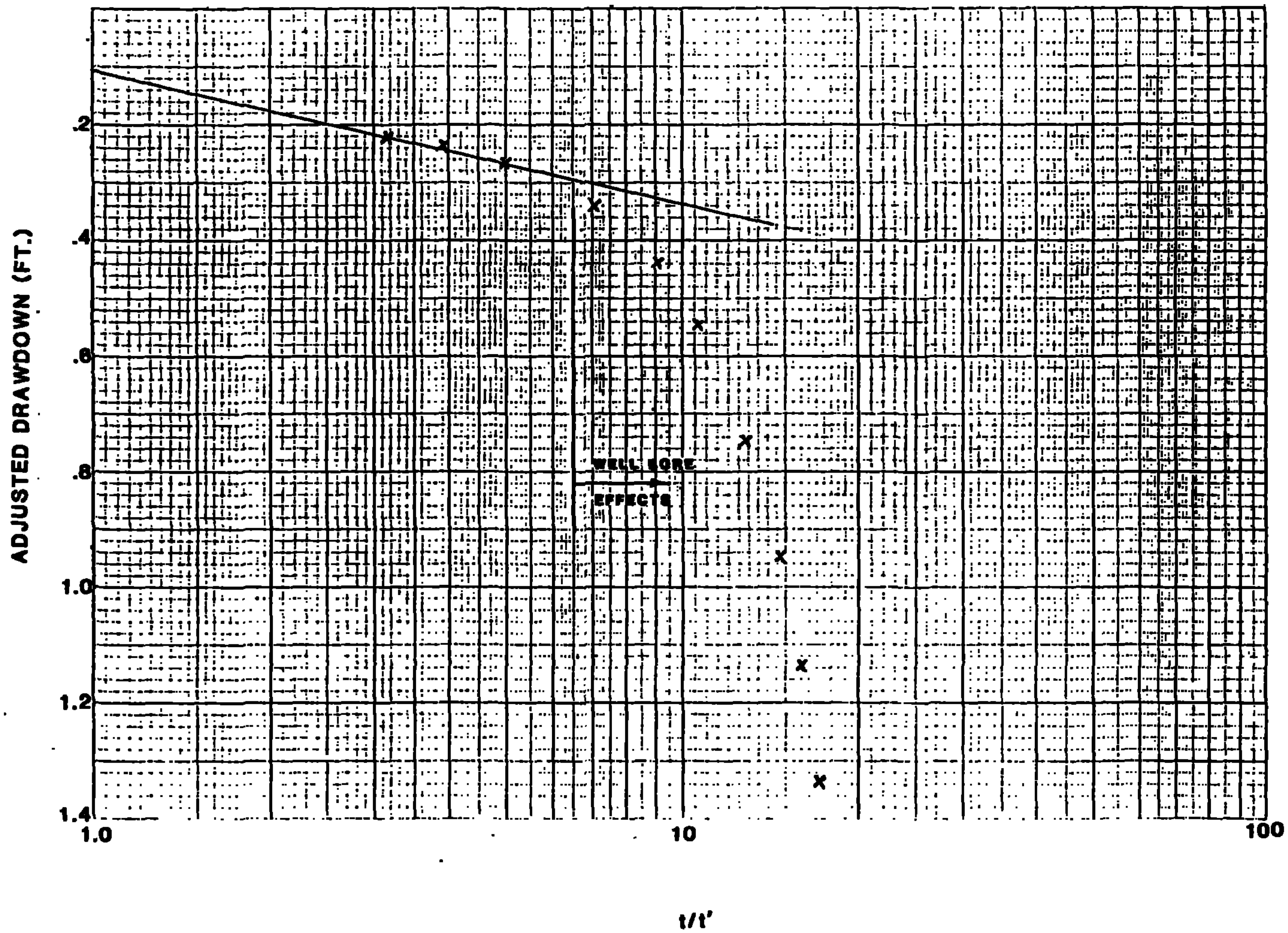
**FIGURE A2-13**
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL: ERT-29
OBSERVATION WELL: ERT-29
DATE(S): AUG. 12, 1988

| PROJECT No. 26 | DATE | REVISION |
|---|---|---|

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

023947




PUMPED WELL ERT-29
RECOVERY ANALYSIS

$$T = \frac{264\ Q\ (gpm)}{\Delta s}$$ gpd/ft

T = 1221 gpd/ft

B-308

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A2-14
THEIS RECOVERY ANALYSIS

PUMPED WELL: ERT-29
OBSERVATION WELL: ERT-29
DATE(S): AUG. 12, 1988

| PROJECT No. 26 | DATE | REVISION |
| --- | --- | --- |

PREPARED BY: APPLIED HYDROLOGY ASSOCIATES, DENVER CO.

BOOKMARK

80

023910

# APPENDIX C

## DEPTH-TO-WATER DATA
## FOR THE
## UPPER ALLUVIAL ZONE

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | FEET EAST | FEET NORTH | TOC ELEVATION | GROUND ELEVATION | TOTAL DEPTH |
|---|---|---|---|---|---|
| ERT-1 | 2606.23 | 3205.78 | 15.18 | 15.2 | 50.00 |
| ERT-1A | 2617.03 | 3204.05 | 14.57 | 14.9 | 20.00 |
| ERT-2 | 2516.53 | 3262.65 | 15.52 | 15.9 | 50.00 |
| ERT-3 | 2580.99 | 3339.00 | 16.33 | 16.6 | 48.00 |
| ERT-4 | 2618.41 | 3215.64 | 15.03 | 15.3 | 47.00 |
| ERT-4A | 2629.34 | 3215.67 | 14.51 | 14.9 | 20.50 |
| ERT-5 | 2527.23 | 3267.92 | 15.81 | 16.1 | 50.00 |
| ERT-6 | 2573.82 | 3331.14 | 15.70 | 16.0 | 50.00 |
| ERT-7 | 2942.93 | 3193.30 | 13.33 | 13.9 | 45.70 |
| ERT-7A | 2954.04 | 3194.47 | 13.86 | 14.2 | 20.00 |
| ERT-8 | 2944.61 | 3202.24 | 13.41 | 14.1 | 49.10 |
| ERT-8A | 2954.14 | 3202.15 | 14.00 | 14.1 | 20.00 |
| ERT-9 | 2715.13 | 3208.70 | 14.39 | 14.8 | 52.00 |
| ERT-9A | 2725.60 | 3208.06 | 14.25 | 14.7 | 20.00 |
| ERT-10 | 2714.20 | 3217.69 | 14.58 | 14.8 | 50.00 |
| ERT-10A | 2725.38 | 3215.92 | 14.20 | 14.7 | 20.00 |
| ERT-20 | 3684.68 | 3055.45 | 13.79 | 11.2 | 42.00 |
| ERT-21 | 3256.66 | 3001.74 | 13.09 | 10.4 | 42.00 |
| ERT-22 | 2946.66 | 3029.98 | 11.24 | 9.6 | 48.00 |
| ERT-23 | 2281.45 | 3044.91 | 15.87 | 12.5 | 55.00 |
| ERT-24 | 2185.07 | 3160.71 | 13.01 | 10.0 | 45.00 |
| ERT-25 | 1989.08 | 3198.34 | 15.42 | 13.0 | 48.00 |
| ERT-26 | 1761.93 | 3165.02 | 13.27 | 11.2 | 48.00 |
| ERT-27 | 2168.47 | 2974.24 | 16.13 | 14.3 | 48.00 |
| ERT-28 | 2176.74 | 2608.16 | 19.82 | 17.8 | 63.00 |
| ERT-29 | 2186.96 | 2431.25 | 19.37 | 17.7 | 58.00 |
| ERT-30 | 2179.55 | 2259.85 | 17.35 | 15.8 | 53.00 |
| GW-2 | 2164.02 | 2761.12 | 18.35 | 16.4 | 58.00 |
| GW-7 | 2165.82 | 2791.17 | 18.36 | 16.4 | 24.00 |
| GW-8 | 3644.19 | 3206.82 | 12.91 | 13.5 | |
| GW-9 | 2554.75 | 3214.54 | 15.00 | 15.1 | |
| GW-13 | 2717.21 | 3831.36 | 12.95 | 10.9 | 24.00 |
| GW-17 | 1925.14 | 3180.19 | 17.03 | 15.3 | 23.00 |
| GW-18 | 1676.48 | 2664.82 | 16.25 | 15.3 | 23.50 |
| GW-19 | 2170.99 | 2137.55 | 16.04 | 13.7 | 23.50 |
| GW-23 | 2202.46 | 1369.31 | 11.65 | 9.9 | 18.00 |
| REI-1 | 2451.99 | 1597.14 | 23.48 | 21.5 | 8.00 |
| REI-3-1 | 3184.64 | 2564.74 | 12.68 | 10.2 | 51.00 |
| REI-3-2 | 3181.57 | 2569.67 | 12.46 | 10.3 | 33.00 |
| REI-3-3 | 3175.99 | 2567.65 | 13.11 | 10.3 | 22.50 |
| REI-5 | 2303.81 | 2577.65 | 22.39 | 19.1 | 16.90 |
| REI-6-1 | 3379.31 | 3184.23 | 13.94 | 12.2 | 50.00 |
| REI-6-2 | 3446.24 | 3186.34 | 14.58 | 13.2 | 25.00 |
| REI-8 | 2190.76 | 1909.74 | 15.52 | 12.5 | 23.00 |
| REI-9 | 2325.40 | 1423.98 | 18.79 | 15.5 | 22.00 |
| REI-10-2 | 2671.78 | 3131.31 | 14.24 | 12.9 | 48.00 |
| REI-10-3 | 2612.74 | 3186.59 | 13.91 | 14.2 | 48.00 |
| REI-10-4 | 2685.62 | 3183.27 | 14.18 | 14.2 | 48.00 |
| REI-12-2 | 1304.45 | 3791.26 | 12.25 | 10.3 | 50.50 |

U23351

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 20-Apr-83 | 29-Apr-83 | 04-May-83 | 12-May-83 | 20-May-83 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 15.96 | 16.08 | 16.48 | 16.07 | 15.72 |
| GW-7 | 7.16 | 7.53 | 7.53 | 7.48 | 7.31 |
| GW-8 | | 3.13 | | | 2.70 |
| GW-9 | | 5.53 | | | 5.09 |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 01-Jun-83 | 08-Jun-83 | 15-Jun-83 | 22-Jun-83 | 30-Nov-83 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 14.57 | 15.11 | 15.93 | 15.70 | 15.57 |
| GW-7 | 5.13 | 5.48 | 5.90 | 5.92 | 7.61 |
| GW-8 | 0.70 | 1.88 | 3.71 | 1.93 | 3.24 |
| GW-9 | 3.92 | 4.48 | 6.12 | 4.76 | 5.23 |
| GW-13 | | | | | 4.06 |
| GW-17 | | | | | 7.60 |
| GW-18 | | | | | 3.42 |
| GW-19 | | | | | 5.97 |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 05-Dec-83 | 07-Dec-83 | 19-Dec-83 | 17-Feb-84 | 24-Feb-84 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 15.32 | 15.40 | 15.21 | 14.87 | 14.90 |
| GW-7 | 6.77 | 7.47 | 7.32 | 6.99 | 7.05 |
| GW-8 | 2.76 | 2.72 | | 1.87 | 2.09 |
| GW-9 | 4.79 | 5.12 | 4.95 | 4.85 | 4.92 |
| GW-13 | 3.33 | 3.33 | | 3.12 | 2.65 |
| GW-17 | 7.29 | 7.36 | 7.35 | 7.11 | 7.19 |
| GW-18 | 2.79 | 3.00 | 2.83 | 2.24 | 2.41 |
| GW-19 | 5.62 | 5.74 | 5.09 | 4.87 | 4.91 |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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# FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 01-Mar-84 | 16-Mar-84 | 12-Apr-84 | 17-May-84 | 01-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | | | | | 5.01 |
| ERT-1A | | | | | |
| ERT-2 | | | | | 5.52 |
| ERT-3 | | | | | 6.64 |
| ERT-4 | | | | | 5.95 |
| ERT-4A | | | | | |
| ERT-5 | | | | | 6.71 |
| ERT-6 | | | | | 6.54 |
| ERT-7 | | | | | 4.57 |
| ERT-7A | | | | | |
| ERT-8 | | | | | 4.48 |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 14.91 | 14.88 | 15.58 | 16.32 | |
| GW-7 | 7.06 | 7.24 | 7.83 | 8.33 | |
| GW-8 | 2.09 | 2.27 | 1.34 | 3.82 | |
| GW-9 | 4.85 | 4.97 | | 5.67 | |
| GW-13 | 2.55 | | 3.19 | 4.00 | |
| GW-17 | 7.22 | 7.26 | | 7.86 | |
| GW-18 | 2.44 | | 1.29 | 4.13 | |
| GW-19 | 4.99 | 5.13 | 5.96 | 6.68 | |
| GW-23 | | | | 4.65 | |
| REI-1 | | | | | 5.16 |
| REI-3-1 | | | 6.23 | | |
| REI-3-2 | | | 5.13 | | |
| REI-3-3 | | | 5.58 | | |
| REI-5 | | | | | |
| REI-6-1 | | | 5.46 | | |
| REI-6-2 | | | 4.75 | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | 4.72 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 03-Nov-87 | 04-Nov-87 | 05-Nov-87 | 06-Nov-87 | 08-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 5.80 | 4.90 | 4.98 | 5.00 | 4.85 |
| ERT-1A | | | | | |
| ERT-2 | 5.38 | 5.19 | 5.49 | 5.52 | 5.40 |
| ERT-3 | 6.40 | 6.42 | 6.54 | 6.53 | 6.42 |
| ERT-4 | 4.82 | 5.84 | 5.88 | 5.94 | 6.75 |
| ERT-4A | | | | | |
| ERT-5 | 6.53 | 6.57 | 6.67 | 6.70 | 6.58 |
| ERT-6 | 6.38 | 6.40 | 6.50 | 6.53 | 6.42 |
| ERT-7 | 4.28 | 4.45 | 4.40 | 4.46 | 4.33 |
| ERT-7A | | | | | |
| ERT-8 | 4.35 | 4.43 | 4.54 | 4.60 | 4.44 |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.98 | 4.03 | 5.41 | 5.16 | 5.01 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.70 | 4.60 | 4.66 | 4.72 | 4.58 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 16-Nov-87 | 17-Nov-87 | 18-Nov-87 | 20-Nov-87 | 25-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 4.82 | 4.74 | 4.86 | | 4.46 |
| ERT-1A | | | | 5.34 | 4.96 |
| ERT-2 | 5.46 | 5.36 | 5.45 | | 5.09 |
| ERT-3 | 6.44 | 6.37 | | | 6.08 |
| ERT-4 | 5.79 | 5.71 | 5.85 | 5.40 | 5.40 |
| ERT-4A | | | | 5.20 | 4.93 |
| ERT-5 | 6.59 | 6.55 | 6.57 | | 6.23 |
| ERT-6 | 6.42 | 6.39 | 6.44 | 6.44 | 6.09 |
| ERT-7 | 4.10 | 3.99 | 4.04 | | 3.66 |
| ERT-7A | | | | 4.89 | 4.13 |
| ERT-8 | 4.23 | 4.13 | 4.10 | | 3.81 |
| ERT-8A | | | | 4.88 | 4.33 |
| ERT-9 | | | | | 4.96 |
| ERT-9A | | | | | 14.22 |
| ERT-10 | | | | 5.46 | 5.10 |
| ERT-10A | | | | 4.96 | 4.58 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.86 | | 4.92 | | 4.54 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.44 | | 4.68 | | 4.12 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 26-Nov-87 | 27-Nov-87 | 28-Nov-87 | 29-Nov-87 | 30-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 4.45 | 4.45 | 4.40 | 4.44 | 4.42 |
| ERT-1A | | 4.97 | 4.90 | 4.94 | 4.94 |
| ERT-2 | 5.07 | 5.06 | 5.00 | 5.02 | 5.03 |
| ERT-3 | 6.05 | 6.04 | 6.01 | 6.04 | 6.04 |
| ERT-4 | 5.40 | 5.35 | 5.40 | | 5.40 |
| ERT-4A | | 4.86 | 5.83 | 4.88 | 4.84 |
| ERT-5 | 6.20 | 6.23 | 6.18 | 6.22 | 6.21 |
| ERT-6 | 6.05 | 6.06 | 6.00 | 6.04 | 6.04 |
| ERT-7 | 3.65 | 4.70 | 3.65 | 3.71 | 3.73 |
| ERT-7A | | 4.14 | 4.11 | 4.15 | 4.16 |
| ERT-8 | | 3.81 | 3.75 | 3.81 | 3.82 |
| ERT-8A | 4.30 | 4.35 | 4.30 | 4.37 | 4.38 |
| ERT-9 | | 4.92 | 4.84 | 4.88 | 4.86 |
| ERT-9A | 14.20 | 10.38 | 8.74 | 8.04 | 7.36 |
| ERT-10 | | 5.11 | 5.00 | 5.04 | 5.08 |
| ERT-10A | 4.60 | 4.56 | 4.54 | 4.56 | 4.58 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.50 | 4.45 | 4.40 | 4.46 | 4.45 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.11 | 4.06 | 4.03 | 4.10 | 4.06 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 03-Dec-87 | 07-Dec-87 | 08-Dec-87 | 09-Dec-87 | 11-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 4.47 | 4.30 | 4.28 | 4.84 | 4.24 |
| ERT-1A | 5.05 | 4.79 | 4.78 | 4.88 | 4.73 |
| ERT-2 | 5.05 | 4.90 | 4.96 | 5.10 | 4.80 |
| ERT-3 | 6.10 | 5.86 | 5.84 | 5.98 | 5.82 |
| ERT-4 | 5.45 | 5.26 | 5.28 | 5.60 | 5.20 |
| ERT-4A | 4.88 | 4.75 | 4.77 | 4.86 | 4.69 |
| ERT-5 | 6.25 | 6.04 | 6.02 | 6.16 | 5.97 |
| ERT-6 | 6.05 | 5.88 | 5.88 | 5.98 | 5.83 |
| ERT-7 | 3.72 | 3.60 | 3.62 | 3.75 | 3.58 |
| ERT-7A | 4.21 | 4.04 | 4.06 | 4.16 | 4.02 |
| ERT-8 | 3.88 | 3.71 | 3.72 | 3.85 | 3.68 |
| ERT-8A | 4.43 | 4.24 | 4.26 | 4.38 | 4.22 |
| ERT-9 | 5.30 | 4.76 | 4.74 | 4.86 | 4.63 |
| ERT-9A | 6.08 | 12.40 | 11.24 | 10.20 | 8.96 |
| ERT-10 | 5.14 | 4.90 | 4.90 | 4.99 | 4.84 |
| ERT-10A | 4.63 | 4.40 | 4.48 | 4.54 | 4.40 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.50 | 4.38 | 4.38 | 4.50 | 4.76 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.14 | 4.00 | 4.00 | 4.09 | 3.90 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

# FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 16-Dec-87 | 20-Dec-87 | 21-Dec-87 | 23-Dec-87 | 26-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 4.52 | 4.44 | 4.18 | 4.08 | 4.24 |
| ERT-1A | 5.13 | 4.92 | 4.74 | 4.60 | 4.74 |
| ERT-2 | 5.05 | 5.04 | 4.86 | 4.66 | 4.86 |
| ERT-3 | 6.02 | 6.04 | 5.80 | 5.68 | 5.86 |
| ERT-4 | 5.52 | 5.42 | 5.20 | 5.06 | 5.22 |
| ERT-4A | 4.95 | 4.78 | 4.10 | 4.56 | 4.82 |
| ERT-5 | 6.25 | 6.24 | 6.04 | 5.82 | 6.02 |
| ERT-6 | 6.00 | 6.03 | 5.90 | 5.64 | 5.86 |
| ERT-7 | 3.70 | 3.71 | 3.34 | 3.44 | 3.60 |
| ERT-7A | 4.10 | 4.12 | 3.80 | 3.90 | 4.00 |
| ERT-8 | 3.80 | 3.82 | 3.48 | 3.56 | 3.70 |
| ERT-8A | 4.33 | 4.40 | 3.80 | 4.10 | 4.19 |
| ERT-9 | 4.85 | 4.88 | 4.68 | 4.50 | 4.80 |
| ERT-9A | 6.08 | 12.04 | 10.50 | 8.40 | 6.60 |
| ERT-10 | 5.03 | 5.05 | 4.88 | 4.70 | 4.85 |
| ERT-10A | 4.56 | 4.58 | 4.36 | 4.26 | 4.40 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.38 | 4.56 | 4.10 | 4.08 | 4.24 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.07 | 4.16 | | 3.78 | 3.86 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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# FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 27-Dec-87 | 28-Dec-87 | 29-Dec-87 | 30-Dec-87 | 31-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 4.26 | 4.22 | 4.32 | 4.07 | 4.04 |
| ERT-1A | 4.84 | 4.74 | 4.82 | 4.64 | 4.56 |
| ERT-2 | 5.00 | 4.88 | 4.92 | 4.72 | 4.67 |
| ERT-3 | 6.02 | 5.88 | 5.96 | 5.74 | 5.69 |
| ERT-4 | 5.29 | 5.20 | 5.30 | 4.10 | 5.02 |
| ERT-4A | 4.70 | 4.64 | 4.72 | 4.59 | 4.54 |
| ERT-5 | 6.12 | 6.04 | 6.14 | 5.89 | 5.84 |
| ERT-6 | 5.92 | 5.86 | 5.96 | 5.73 | 5.68 |
| ERT-7 | | 3.60 | 3.66 | 3.47 | 3.47 |
| ERT-7A | | 3.96 | 4.04 | 3.89 | 3.91 |
| ERT-8 | | 3.68 | 3.80 | 3.53 | 3.63 |
| ERT-8A | | 4.14 | 4.22 | 4.08 | 4.07 |
| ERT-9 | 4.70 | 4.76 | 4.80 | 5.54 | 4.43 |
| ERT-9A | 6.18 | 5.78 | 5.64 | 5.34 | 5.11 |
| ERT-10 | 4.90 | 4.90 | 4.96 | 4.79 | 4.66 |
| ERT-10A | | 4.40 | 4.48 | 4.28 | 4.25 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | 4.22 | 4.32 | 4.10 | 4.04 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | 3.92 | 4.02 | 3.79 | 3.69 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

# FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 01-Jan-88 | 02-Jan-88 | 03-Jan-88 | 04-Jan-88 | 17-Jan-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.20 | 4.22 | 4.08 | 4.25 | |
| ERT-1A | 4.70 | 4.81 | 5.59 | 4.75 | |
| ERT-2 | 4.80 | 4.78 | 4.69 | 4.89 | 4.74 |
| ERT-3 | 5.84 | 5.86 | 5.72 | 5.93 | 5.72 |
| ERT-4 | 5.17 | 5.25 | 5.04 | 5.23 | |
| ERT-4A | 4.66 | 4.66 | 4.57 | 4.73 | |
| ERT-5 | 6.00 | 6.00 | 5.89 | 6.07 | 5.92 |
| ERT-6 | 5.85 | 5.92 | 5.73 | 5.93 | 5.78 |
| ERT-7 | 3.57 | 3.60 | 3.50 | 3.68 | 3.50 |
| ERT-7A | 3.95 | 3.93 | 3.90 | 4.04 | 3.90 |
| ERT-8 | 3.68 | 3.68 | 3.58 | 3.73 | 3.59 |
| ERT-8A | 4.14 | 4.20 | 4.09 | 4.21 | 4.01 |
| ERT-9 | 4.62 | 4.75 | 4.53 | 4.68 | 4.48 |
| ERT-9A | 4.94 | 4.99 | 4.74 | 4.70 | 4.51 |
| ERT-10 | 4.82 | 4.90 | 4.68 | 4.80 | 4.68 |
| ERT-10A | 4.36 | 4.40 | 4.19 | 4.36 | 4.24 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.90 | 4.90 | 4.06 | 4.23 | 4.07 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 3.87 | 3.92 | 3.76 | 3.88 | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 18-Jan-88 | 19-Jan-88 | 20-Jan-88 | 21-Jan-88 | 22-Jan-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.08 | 4.11 | 4.40 | 4.39 | 4.37 |
| ERT-1A | 4.48 | 4.40 | 4.66 | 4.77 | 4.82 |
| ERT-2 | 4.64 | 4.68 | 5.04 | 5.02 | 5.00 |
| ERT-3 | 5.40 | 6.08 | 5.73 | 6.06 | 6.05 |
| ERT-4 | 5.06 | 5.04 | 5.38 | 5.34 | 5.32 |
| ERT-4A | 4.50 | 5.52 | 4.84 | 4.85 | 4.79 |
| ERT-5 | 5.84 | 5.84 | 6.26 | 6.20 | 6.22 |
| ERT-6 | 5.38 | 5.73 | 6.10 | 6.05 | 6.06 |
| ERT-7 | 3.38 | 3.39 | 4.74 | 6.70 | 3.69 |
| ERT-7A | 3.78 | 3.98 | 4.03 | 4.02 | 4.09 |
| ERT-8 | 3.50 | 3.48 | 3.86 | 3.84 | 3.81 |
| ERT-8A | 3.93 | 3.82 | 4.17 | 4.17 | 4.26 |
| ERT-9 | 4.41 | 4.32 | 4.79 | 4.88 | 4.75 |
| ERT-9A | 4.41 | 4.40 | 4.90 | 9.55 | 5.33 |
| ERT-10 | 4.58 | 4.54 | 4.54 | 4.92 | 4.90 |
| ERT-10A | 4.18 | 4.19 | 4.48 | 4.40 | 4.34 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.01 | 3.97 | 4.40 | 4.31 | 4.48 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | 4.22 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 23-Jan-88 | 24-Jan-88 | 03-Feb-88 | 04-Feb-88 | 09-Feb-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.30 | 4.30 | | 4.50 | 4.26 |
| ERT-1A | 4.63 | 4.63 | 4.80 | 4.76 | |
| ERT-2 | 4.76 | | | 5.09 | 4.92 |
| ERT-3 | 5.82 | | | 6.14 | 6.01 |
| ERT-4 | 5.17 | 5.17 | | 5.43 | 5.24 |
| ERT-4A | 4.60 | 4.60 | 4.78 | | 4.71 |
| ERT-5 | 5.96 | | | 6.46 | 6.11 |
| ERT-6 | 5.82 | | | 6.18 | 5.96 |
| ERT-7 | 3.50 | 3.50 | 3.67 | | 3.56 |
| ERT-7A | 3.92 | 3.92 | 4.14 | | 4.01 |
| ERT-8 | 3.62 | 3.62 | | 3.84 | 3.68 |
| ERT-8A | 4.08 | 4.08 | 4.42 | | 4.19 |
| ERT-9 | 4.53 | 4.53 | 4.73 | | 4.62 |
| ERT-9A | 4.79 | 4.79 | 4.68 | | 4.55 |
| ERT-10 | 4.68 | 4.68 | 4.86 | | 4.75 |
| ERT-10A | 4.28 | 4.28 | 4.40 | | 4.36 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.40 | 4.40 | | 4.69 | 4.92 |
| REI-3-1 | | | | 3.36 | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 4.10 | 4.10 | | | 3.02 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 11-Feb-88 | 12-Feb-88 | 13-Feb-88 | 14-Feb-88 | 15-Feb-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.36 | 4.37 | 4.35 | 4.34 | 4.36 |
| ERT-1A | 4.82 | 4.89 | 4.66 | 4.68 | 4.84 |
| ERT-2 | 4.98 | 5.02 | 5.00 | 4.96 | 5.00 |
| ERT-3 | 6.04 | 6.10 | 6.12 | 6.08 | 6.06 |
| ERT-4 | 5.30 | 5.35 | 5.31 | 5.35 | 5.32 |
| ERT-4A | 4.80 | 4.84 | 4.81 | 4.77 | 4.80 |
| ERT-5 | 6.22 | 6.23 | 6.20 | 6.10 | 6.21 |
| ERT-6 | 6.06 | 6.10 | 6.10 | 6.04 | 6.02 |
| ERT-7 | 3.68 | 3.70 | 3.70 | 3.66 | 3.66 |
| ERT-7A | 4.04 | 4.10 | 4.09 | 4.09 | 4.00 |
| ERT-8 | 3.80 | 3.84 | 3.83 | 3.84 | 3.78 |
| ERT-8A | 4.22 | 4.25 | 4.24 | 4.22 | 4.18 |
| ERT-9 | 4.74 | 4.74 | 4.73 | 4.71 | 4.72 |
| ERT-9A | 4.60 | 4.70 | 4.76 | 4.72 | 4.72 |
| ERT-10 | 4.87 | 4.90 | 4.90 | 4.82 | 4.90 |
| ERT-10A | 4.36 | 4.46 | 4.46 | 4.48 | 4.42 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.42 | 4.40 | 4.38 | 3.89 | 4.40 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 3.82 | 4.00 | 4.00 | 4.70 | 3.96 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 18-Feb-88 | 03-Mar-88 | 16-Mar-88 | 29-Mar-88 | 02-Apr-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.30 | 4.36 | 4.28 | 3.94 | 4.05 |
| ERT-1A | 4.84 | 4.70 | 4.78 | 4.39 | 4.52 |
| ERT-2 | 4.96 | 4.82 | | 4.90 | 4.87 |
| ERT-3 | 6.04 | 6.05 | | 5.58 | 5.78 |
| ERT-4 | 5.34 | 5.30 | 5.24 | 5.04 | 4.97 |
| ERT-4A | 4.78 | 4.62 | 4.68 | 4.56 | 4.50 |
| ERT-5 | 6.22 | 6.26 | | 6.10 | 5.96 |
| ERT-6 | 6.00 | 6.06 | | 5.60 | 5.79 |
| ERT-7 | 3.62 | 3.41 | 3.72 | 3.62 | 3.48 |
| ERT-7A | 4.00 | 3.76 | 4.04 | 4.00 | 3.87 |
| ERT-8 | 3.74 | 4.00 | 3.67 | 3.32 | 3.53 |
| ERT-8A | 4.21 | 4.30 | 4.24 | 4.20 | 4.05 |
| ERT-9 | 4.63 | 4.52 | 4.73 | 4.55 | 4.38 |
| ERT-9A | 4.64 | 4.46 | 4.73 | 4.52 | 4.29 |
| ERT-10 | 4.81 | 4.68 | 4.89 | 4.22 | 4.61 |
| ERT-10A | 4.40 | 4.50 | 4.48 | 4.28 | 4.10 |
| ERT-20 | | 3.64 | | 3.58 | |
| ERT-21 | | 3.50 | | 6.56 | |
| ERT-22 | | 1.70 | | 1.66 | |
| ERT-23 | | 6.10 | | 5.88 | |
| ERT-24 | | 3.04 | | 3.42 | |
| ERT-25 | | | | | 5.35 |
| ERT-26 | | | | | 3.05 |
| ERT-27 | | | | | 4.50 |
| ERT-28 | | | | | 13.05 |
| ERT-29 | | | | | 8.97 |
| ERT-30 | | | | | 12.44 |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 4.32 | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | 4.76 | 4.72 | 4.76 | 3.36 |
| REI-10-3 | 3.57 | | 4.12 | 3.90 | 3.80 |
| REI-10-4 | | 4.32 | 4.41 | 3.94 | 4.03 |
| REI-12-2 | | | | | |

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 11-Apr-88 | 13-Apr-88 | 25-Apr-88 | 07-May-88 | 14-May-88 |
|---|---|---|---|---|---|
| ERT-1 | 4.30 | 4.32 | 4.53 | 5.61 | 5.75 |
| ERT-1A | 4.75 | 4.81 | 5.02 | 4.98 | 5.00 |
| ERT-2 | 4.98 | | 5.15 | 5.92 | 5.98 |
| ERT-3 | 5.90 | | 6.24 | 6.77 | 6.75 |
| ERT-4 | 5.28 | 5.32 | 5.51 | 5.43 | 5.50 |
| ERT-4A | 4.72 | 4.75 | 4.96 | 4.91 | 4.98 |
| ERT-5 | 6.01 | | 6.36 | 6.25 | 6.25 |
| ERT-6 | 5.98 | | 6.20 | 6.09 | 6.20 |
| ERT-7 | 3.68 | 3.66 | 3.89 | 3.82 | 3.85 |
| ERT-7A | 4.00 | 4.03 | 4.29 | 4.27 | 4.31 |
| ERT-8 | 3.72 | 3.78 | 3.99 | 3.91 | 3.90 |
| ERT-8A | 4.20 | 4.22 | 4.46 | 4.44 | 4.58 |
| ERT-9 | 4.68 | 4.63 | 4.87 | 4.81 | 4.83 |
| ERT-9A | 4.49 | 4.62 | 4.72 | 4.48 | 4.43 |
| ERT-10 | 4.84 | 5.17 | 5.07 | 5.01 | 5.00 |
| ERT-10A | 4.38 | 4.40 | 4.60 | 4.57 | 4.67 |
| ERT-20 | 3.75 | | 4.45 | | |
| ERT-21 | 3.53 | | 3.92 | | |
| ERT-22 | 1.69 | | 1.94 | | |
| ERT-23 | 5.89 | | 6.16 | | |
| ERT-24 | 3.22 | | 3.49 | | |
| ERT-25 | 5.57 | | 5.84 | | |
| ERT-26 | 3.15 | | 3.73 | | |
| ERT-27 | 4.75 | | 5.37 | | |
| ERT-28 | 12.36 | | 11.27 | | |
| ERT-29 | 8.91 | | 9.35 | | |
| ERT-30 | 12.64 | | 13.26 | | |
| GW-2 | 13.82 | | | | |
| GW-7 | 7.20 | | | | |
| GW-8 | 4.70 | | | | |
| GW-9 | 15.00 | | | | |
| GW-13 | 3.58 | | | | |
| GW-17 | 7.26 | | | | |
| GW-18 | 3.85 | | | | |
| GW-19 | 5.90 | | | | |
| GW-23 | 4.80 | | | | |
| REI-1 | 6.01 | | | | |
| REI-3-1 | 3.36 | | | | |
| REI-3-2 | 3.94 | | | | |
| REI-3-3 | 3.94 | | | | |
| REI-5 | 11.76 | | | | |
| REI-6-1 | 4.12 | | | | |
| REI-6-2 | 4.71 | | | | |
| REI-8 | 5.92 | | | | |
| REI-9 | 11.61 | | | | |
| REI-10-2 | 4.68 | 4.74 | 4.96 | 4.88 | 4.85 |
| REI-10-3 | 3.95 | 4.18 | 4.33 | 5.94 | 5.98 |
| REI-10-4 | 4.24 | 4.26 | 4.50 | 4.83 | 4.91 |
| REI-12-2 | 4.09 | | | | |

# FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 24-May-88 | 28-May-88 | 07-Jun-88 | 20-Jun-88 | 24-Jun-88 |
|---|---|---|---|---|---|
| ERT-1 | 5.92 | 6.09 | 6.10 | | 6.50 |
| ERT-1A | 5.32 | 5.47 | 5.50 | | 6.00 |
| ERT-2 | 6.28 | 6.43 | 6.45 | 6.50 | 6.80 |
| ERT-3 | 7.08 | 7.22 | 7.23 | 7.78 | 7.50 |
| ERT-4 | 5.78 | 5.95 | 5.95 | 5.36 | 6.30 |
| ERT-4A | 5.20 | 5.40 | 5.43 | 5.62 | 5.76 |
| ERT-5 | 6.58 | 6.75 | 6.76 | 6.20 | 7.08 |
| ERT-6 | 6.40 | 6.60 | 6.60 | 6.90 | 6.90 |
| ERT-7 | 4.18 | 4.38 | 4.28 | 4.72 | 4.77 |
| ERT-7A | 4.62 | 4.82 | 4.74 | 5.20 | 5.28 |
| ERT-8 | 4.26 | 4.50 | 4.34 | 4.90 | 4.92 |
| ERT-8A | 4.76 | 4.97 | 4.79 | 5.32 | 5.42 |
| ERT-9 | 5.14 | 5.32 | 5.32 | 5.78 | 5.72 |
| ERT-9A | 4.84 | 5.00 | 4.99 | 5.46 | 5.34 |
| ERT-10 | 4.95 | 5.50 | 5.51 | 5.90 | 5.90 |
| ERT-10A | 4.82 | 5.05 | 5.00 | 5.00 | 5.50 |
| ERT-20 | 5.10 | | | 5.73 | |
| ERT-21 | 4.32 | | | 5.89 | |
| ERT-22 | 2.26 | | | 2.87 | |
| ERT-23 | 6.52 | | | 7.04 | |
| ERT-24 | 3.80 | | | 4.28 | |
| ERT-25 | 6.44 | | | 6.90 | |
| ERT-26 | 4.45 | | | 4.67 | |
| ERT-27 | 5.88 | | | 6.16 | |
| ERT-28 | 11.89 | | 12.55 | | |
| ERT-29 | 10.40 | | | 10.90 | |
| ERT-30 | 13.70 | | | 14.37 | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | 4.66 | | | 4.97 | |
| REI-3-2 | | | | | |
| REI-3-3 | 4.82 | 5.46 | | | |
| REI-5 | 12.84 | | | 13.52 | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | 4.80 | 5.40 | 5.42 | 5.82 | 5.80 |
| REI-10-3 | 4.74 | 5.00 | 4.97 | 5.30 | 5.32 |
| REI-10-4 | 4.18 | 5.43 | 5.41 | 5.84 | 5.82 |
| REI-12-2 | | | | | |

023968

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

| WELL | DEPTH TO WATER FROM TOP OF CASING (FEET) 29-Jun-88 | 08-Jul-88 | 18-Jul-88 | 06-Sep-88 |
|---|---|---|---|---|
| ERT-1 | 6.59 | 6.77 | 7.10 | 6.10 |
| ERT-1A | 6.35 | 6.30 | 6.32 | 6.15 |
| ERT-2 | 6.90 | 7.10 | 7.32 | 6.41 |
| ERT-3 | 7.64 | 7.83 | 8.01 | 7.18 |
| ERT-4 | 5.33 | 6.63 | 6.88 | 5.95 |
| ERT-4A | 5.85 | 5.98 | 6.34 | |
| ERT-5 | 7.18 | 7.38 | 7.60 | 6.70 |
| ERT-6 | 7.00 | 7.20 | 7.40 | 6.57 |
| ERT-7 | 4.89 | 5.10 | 5.30 | 4.22 |
| ERT-7A | 5.38 | 5.63 | 5.85 | 4.80 |
| ERT-8 | 5.00 | 5.21 | 5.41 | 4.31 |
| ERT-8A | 5.50 | 5.74 | 6.86 | 4.95 |
| ERT-9 | 5.84 | 6.02 | 6.28 | 5.35 |
| ERT-9A | 5.50 | 5.70 | 5.90 | 5.08 |
| ERT-10 | 6.00 | 6.20 | 6.45 | 5.56 |
| ERT-10A | 5.58 | 5.76 | 6.06 | 5.19 |
| ERT-20 | | | 6.52 | 5.29 |
| ERT-21 | | | 5.68 | 4.20 |
| ERT-22 | | | 3.45 | 3.20 |
| ERT-23 | | | 7.72 | 6.87 |
| ERT-24 | | | 4.61 | 3.98 |
| ERT-25 | | | 7.13 | 6.41 |
| ERT-26 | | | 5.23 | 4.50 |
| ERT-27 | | | 9.91 | 6.67 |
| ERT-28 | | | 13.50 | 13.95 |
| ERT-29 | | | 11.90 | 11.68 |
| ERT-30 | | | 15.01 | 14.63 |
| GW-2 | | | | |
| GW-7 | | | | |
| GW-8 | | | | |
| GW-9 | | | | |
| GW-13 | | | | |
| GW-17 | | | | |
| GW-18 | | | | |
| GW-19 | | | | |
| GW-23 | | | | |
| REI-1 | | | | |
| REI-3-1 | | | 12.65 | 14.03 |
| REI-3-2 | | | | |
| REI-3-3 | | | 9.19 | |
| REI-5 | | | 12.65 | 14.03 |
| REI-6-1 | | | | |
| REI-6-2 | | | | |
| REI-8 | | | | |
| REI-9 | | | | |
| REI-10-2 | 5.90 | 5.90 | | |
| REI-10-3 | 5.43 | 5.63 | 5.90 | 4.98 |
| REI-10-4 | 5.93 | 5.94 | 6.18 | 5.24 |
| REI-12-2 | | | | |

J23969

FRENCH LIMITED DEPTH-TO-WATER DATA BY DATES

DEPTH TO WATER FROM TOP OF CASING (FEET)

| WELL | 17-Oct-88 | 16-Nov-88 | 29-Nov-88 |
|---|---|---|---|
| ERT-1 | 6.77 | | |
| ERT-1A | | | 7.15 |
| ERT-2 | | | 7.60 |
| ERT-3 | 7.90 | | 8.34 |
| ERT-4 | | | 3.03 |
| ERT-4A | | | 6.75 |
| ERT-5 | | | 7.85 |
| ERT-6 | | | 7.73 |
| ERT-7 | | | 5.20 |
| ERT-7A | | | 5.80 |
| ERT-8 | 5.10 | | 5.35 |
| ERT-8A | | | 5.94 |
| ERT-9 | | | 6.35 |
| ERT-9A | | | 6.08 |
| ERT-10 | 6.15 | | 6.55 |
| ERT-10A | | | 6.17 |
| ERT-20 | 6.30 | | 6.44 |
| ERT-21 | 4.94 | | 5.12 |
| ERT-22 | 2.84 | | 3.09 |
| ERT-23 | 7.55 | | 7.95 |
| ERT-24 | 4.73 | | 5.12 |
| ERT-25 | 6.90 | | 7.36 |
| ERT-26 | 5.25 | | 5.58 |
| ERT-27 | 7.28 | | 7.57 |
| ERT-28 | 14.50 | | 15.86 |
| ERT-29 | 12.21 | | 12.59 |
| ERT-30 | 15.05 | | 15.44 |
| GW-2 | | | |
| GW-7 | | | |
| GW-8 | | | |
| GW-9 | | | |
| GW-13 | | | |
| GW-17 | | | |
| GW-18 | | | |
| GW-19 | | | |
| GW-23 | | | |
| REI-1 | | | |
| REI-3-1 | | | |
| REI-3-2 | | | |
| REI-3-3 | | | |
| REI-5 | | | |
| REI-6-1 | | | |
| REI-6-2 | | | |
| REI-8 | | | |
| REI-9 | | | |
| REI-10-2 | | | 6.39 |
| REI-10-3 | 5.64 | | 7.56 |
| REI-10-4 | 6.03 | | 6.27 |
| REI-12-2 | | | |

BOOKMARK

1173

023970

# APPENDIX D

## WATER LEVEL ELEVATIONS

## FOR THE

## UPPER ALLUVIAL ZONE

023971

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | FEET EAST | FEET NORTH | TOC ELEVATION | GROUND ELEVATION | TOTAL DEPTH |
|---|---|---|---|---|---|
| ERT-1 | 2606.23 | 3205.78 | 15.18 | 15.2 | 50.00 |
| ERT-1A | 2617.03 | 3204.05 | 14.57 | 14.9 | 20.00 |
| ERT-2 | 2516.53 | 3262.65 | 15.52 | 15.9 | 50.00 |
| ERT-3 | 2580.99 | 3339.00 | 16.33 | 16.6 | 48.00 |
| ERT-4 | 2618.41 | 3215.64 | 15.03 | 15.3 | 47.00 |
| ERT-4A | 2629.34 | 3215.67 | 14.51 | 14.9 | 20.50 |
| ERT-5 | 2527.23 | 3267.92 | 15.81 | 16.1 | 50.00 |
| ERT-6 | 2573.82 | 3331.14 | 15.70 | 16.0 | 50.00 |
| ERT-7 | 2942.93 | 3193.30 | 13.33 | 13.9 | 45.70 |
| ERT-7A | 2954.04 | 3194.47 | 13.86 | 14.2 | 20.00 |
| ERT-8 | 2944.61 | 3202.24 | 13.41 | 14.1 | 49.10 |
| ERT-8A | 2954.14 | 3202.15 | 14.00 | 14.1 | 20.00 |
| ERT-9 | 2715.13 | 3208.70 | 14.39 | 14.8 | 52.00 |
| ERT-9A | 2725.60 | 3208.06 | 14.25 | 14.7 | 20.00 |
| ERT-10 | 2714.20 | 3217.69 | 14.58 | 14.8 | 50.00 |
| ERT-10A | 2725.38 | 3215.92 | 14.20 | 14.7 | 20.00 |
| ERT-20 | 3684.68 | 3055.45 | 13.79 | 11.2 | 42.00 |
| ERT-21 | 3256.66 | 3001.74 | 13.09 | 10.4 | 42.00 |
| ERT-22 | 2946.66 | 3029.98 | 11.24 | 9.6 | 48.00 |
| ERT-23 | 2281.45 | 3044.91 | 15.87 | 12.5 | 55.00 |
| ERT-24 | 2185.07 | 3160.71 | 13.01 | 10.0 | 45.00 |
| ERT-25 | 1989.08 | 3198.34 | 15.42 | 13.0 | 48.00 |
| ERT-26 | 1761.93 | 3165.02 | 13.27 | 11.2 | 48.00 |
| ERT-27 | 2168.47 | 2974.24 | 16.13 | 14.3 | 48.00 |
| ERT-28 | 2176.74 | 2608.16 | 19.82 | 17.8 | 63.00 |
| ERT-29 | 2186.96 | 2431.25 | 19.37 | 17.7 | 58.00 |
| ERT-30 | 2179.55 | 2259.85 | 17.35 | 15.8 | 53.00 |
| GW-2 | 2164.02 | 2761.12 | 18.35 | 16.4 | 58.00 |
| GW-7 | 2165.82 | 2791.17 | 18.36 | 16.4 | 24.00 |
| GW-8 | 3644.19 | 3206.82 | 12.91 | 13.5 | |
| GW-9 | 2554.75 | 3214.54 | 15.00 | 15.1 | |
| GW-13 | 2717.21 | 3831.36 | 12.95 | 10.9 | 24.00 |
| GW-17 | 1925.14 | 3180.19 | 17.03 | 15.3 | 23.00 |
| GW-18 | 1676.48 | 2664.82 | 16.25 | 15.3 | 23.50 |
| GW-19 | 2170.99 | 2137.55 | 16.04 | 13.7 | 23.50 |
| GW-23 | 2202.46 | 1369.31 | 11.65 | 9.9 | 18.00 |
| REI-1 | 2451.99 | 1597.14 | 23.48 | 21.5 | 8.00 |
| REI-3-1 | 3184.64 | 2564.74 | 12.68 | 10.2 | 51.00 |
| REI-3-2 | 3181.57 | 2569.67 | 12.46 | 10.3 | 33.00 |
| REI-3-3 | 3175.99 | 2567.65 | 13.11 | 10.3 | 22.50 |
| REI-5 | 2303.81 | 2577.65 | 22.39 | 19.1 | 16.90 |
| REI-6-1 | 3379.31 | 3184.23 | 13.94 | 12.2 | 50.00 |
| REI-6-2 | 3446.24 | 3186.34 | 14.58 | 13.2 | 25.00 |
| REI-8 | 2190.76 | 1909.74 | 15.52 | 12.5 | 23.00 |
| REI-9 | 2325.40 | 1423.98 | 18.79 | 15.5 | 22.00 |
| REI-10-2 | 2671.78 | 3131.31 | 14.24 | 12.9 | 48.00 |
| REI-10-3 | 2612.74 | 3186.59 | 13.91 | 14.2 | 48.00 |
| REI-10-4 | 2685.62 | 3183.27 | 14.18 | 14.2 | 48.00 |
| REI-12-2 | 1304.45 | 3791.26 | 12.25 | 10.3 | 50.50 |

023972

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 20-Apr-83 | 29-Apr-83 | 04-May-83 | 12-May-83 | 20-May-83 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 2.39 | 2.27 | 1.87 | 2.28 | 2.63 |
| GW-7 | 11.20 | 10.83 | 10.83 | 10.88 | 11.05 |
| GW-8 | | 9.78 | | | 10.21 |
| GW-9 | | 9.47 | | | 9.91 |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 01-Jun-83 | 08-Jun-83 | 15-Jun-83 | 22-Jun-83 | 30-Nov-83 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 3.78 | 3.24 | 2.42 | 2.65 | 2.78 |
| GW-7 | 13.23 | 12.88 | 12.46 | 12.44 | 10.75 |
| GW-8 | 12.21 | 11.03 | 9.20 | 10.98 | 9.67 |
| GW-9 | 11.08 | 10.52 | 8.88 | 10.24 | 9.77 |
| GW-13 | | | | | 8.89 |
| GW-17 | | | | | 9.43 |
| GW-18 | | | | | 12.83 |
| GW-19 | | | | | 10.07 |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023974

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 05-Dec-83 | 07-Dec-83 | 19-Dec-83 | 17-Feb-84 | 24-Feb-84 |
|---|---|---|---|---|---|
| ERT-1 | | | | | |
| ERT-1A | | | | | |
| ERT-2 | | | | | |
| ERT-3 | | | | | |
| ERT-4 | | | | | |
| ERT-4A | | | | | |
| ERT-5 | | | | | |
| ERT-6 | | | | | |
| ERT-7 | | | | | |
| ERT-7A | | | | | |
| ERT-8 | | | | | |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 3.03 | 2.95 | 3.14 | 3.48 | 3.45 |
| GW-7 | 11.59 | 10.89 | 11.04 | 11.37 | 11.31 |
| GW-8 | 10.15 | 10.19 | | 11.04 | 10.82 |
| GW-9 | 10.21 | 9.88 | 10.05 | 10.15 | 10.08 |
| GW-13 | 9.62 | 9.62 | | 9.83 | 10.30 |
| GW-17 | 9.74 | 9.67 | 9.68 | 9.92 | 9.84 |
| GW-18 | 13.46 | 13.25 | 13.42 | 14.01 | 13.84 |
| GW-19 | 10.42 | 10.30 | 10.95 | 11.17 | 11.13 |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023975

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 01-Mar-84 | 16-Mar-84 | 12-Apr-84 | 17-May-84 | 01-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | | | | | 10.17 |
| ERT-1A | | | | | |
| ERT-2 | | | | | 10.00 |
| ERT-3 | | | | | 9.69 |
| ERT-4 | | | | | 9.08 |
| ERT-4A | | | | | |
| ERT-5 | | | | | 9.10 |
| ERT-6 | | | | | 9.16 |
| ERT-7 | | | | | 8.76 |
| ERT-7A | | | | | |
| ERT-8 | | | | | 8.93 |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | 3.44 | 3.47 | 2.77 | 2.03 | |
| GW-7 | 11.30 | 11.12 | 10.53 | 10.03 | |
| GW-8 | 10.82 | 10.64 | 11.57 | 9.09 | |
| GW-9 | 10.15 | 10.03 | | 9.33 | |
| GW-13 | 10.40 | | 9.76 | 8.95 | |
| GW-17 | 9.81 | 9.77 | | 9.17 | |
| GW-18 | 13.81 | | 14.96 | 12.12 | |
| GW-19 | 11.05 | 10.91 | 10.08 | 9.36 | |
| GW-23 | | | | 7.00 | |
| REI-1 | | | | | 18.32 |
| REI-3-1 | | | 6.45 | | |
| REI-3-2 | | | 7.33 | | |
| REI-3-3 | | | 7.53 | | |
| REI-5 | | | | | |
| REI-6-1 | | | 8.48 | | |
| REI-6-2 | | | 9.83 | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | 9.19 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023976

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 03-Nov-87 | 04-Nov-87 | 05-Nov-87 | 06-Nov-87 | 08-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 9.38 | 10.28 | 10.20 | 10.18 | 10.33 |
| ERT-1A | | | | | |
| ERT-2 | 10.14 | 10.33 | 10.03 | 10.00 | 10.12 |
| ERT-3 | 9.93 | 9.91 | 9.79 | 9.80 | 9.91 |
| ERT-4 | 10.21 | 9.19 | 9.15 | 9.09 | 8.28 |
| ERT-4A | | | | | |
| ERT-5 | 9.29 | 9.24 | 9.14 | 9.11 | 9.23 |
| ERT-6 | 9.33 | 9.30 | 9.20 | 9.17 | 9.28 |
| ERT-7 | 9.06 | 8.88 | 8.93 | 8.87 | 9.00 |
| ERT-7A | | | | | |
| ERT-8 | 9.06 | 8.98 | 8.87 | 8.81 | 8.97 |
| ERT-8A | | | | | |
| ERT-9 | | | | | |
| ERT-9A | | | | | |
| ERT-10 | | | | | |
| ERT-10A | | | | | |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 18.50 | 19.45 | 18.07 | 18.32 | 18.47 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.22 | 9.31 | 9.25 | 9.19 | 9.33 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023977

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 16-Nov-87 | 17-Nov-87 | 18-Nov-87 | 20-Nov-87 | 25-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 10.36 | 10.44 | 10.32 | | 10.72 |
| ERT-1A | | | | 9.23 | 9.61 |
| ERT-2 | 10.06 | 10.16 | 10.07 | | 10.43 |
| ERT-3 | 9.89 | 9.96 | | | 10.25 |
| ERT-4 | 9.24 | 9.32 | 9.18 | 9.63 | 9.63 |
| ERT-4A | | | | 9.31 | 9.58 |
| ERT-5 | 9.22 | 9.26 | 9.24 | | 9.58 |
| ERT-6 | 9.28 | 9.31 | 9.26 | 9.26 | 9.61 |
| ERT-7 | 9.23 | 9.34 | 9.29 | | 9.67 |
| ERT-7A | | | | 8.97 | 9.73 |
| ERT-8 | 9.18 | 9.28 | 9.31 | | 9.60 |
| ERT-8A | | | | 9.12 | 9.67 |
| ERT-9 | | | | | 9.43 |
| ERT-9A | | | | | 0.03 |
| ERT-10 | | | | 9.12 | 9.48 |
| ERT-10A | | | | 9.24 | 9.62 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 18.62 | | 18.56 | | 18.94 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.47 | | 9.23 | | 9.79 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023978

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 26-Nov-87 | 27-Nov-87 | 28-Nov-87 | 29-Nov-87 | 30-Nov-87 |
|---|---|---|---|---|---|
| ERT-1 | 10.73 | 10.73 | 10.78 | 10.74 | 10.76 |
| ERT-1A | | 9.60 | 9.67 | 9.63 | 9.63 |
| ERT-2 | 10.45 | 10.46 | 10.52 | 10.50 | 10.49 |
| ERT-3 | 10.28 | 10.29 | 10.32 | 10.29 | 10.29 |
| ERT-4 | 9.63 | 9.68 | 9.63 | | 9.63 |
| ERT-4A | | 9.65 | 8.68 | 9.63 | 9.67 |
| ERT-5 | 9.61 | 9.58 | 9.63 | 9.59 | 9.60 |
| ERT-6 | 9.65 | 9.64 | 9.70 | 9.66 | 9.66 |
| ERT-7 | 9.68 | 8.63 | 9.68 | 9.62 | 9.60 |
| ERT-7A | | 9.72 | 9.75 | 9.71 | 9.70 |
| ERT-8 | | 9.60 | 9.66 | 9.60 | 9.59 |
| ERT-8A | 9.70 | 9.65 | 9.70 | 9.63 | 9.62 |
| ERT-9 | | 9.47 | 9.55 | 9.51 | 9.53 |
| ERT-9A | 0.05 | 3.87 | 5.51 | 6.21 | 6.89 |
| ERT-10 | | 9.47 | 9.58 | 9.54 | 9.50 |
| ERT-10A | 9.60 | 9.64 | 9.66 | 9.64 | 9.62 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 18.98 | 19.03 | 19.08 | 19.02 | 19.03 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.80 | 9.85 | 9.88 | 9.81 | 9.85 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023979

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 03-Dec-87 | 07-Dec-87 | 08-Dec-87 | 09-Dec-87 | 11-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 10.71 | 10.88 | 10.90 | 10.34 | 10.94 |
| ERT-1A | 9.52 | 9.78 | 9.79 | 9.69 | 9.84 |
| ERT-2 | 10.47 | 10.62 | 10.56 | 10.42 | 10.72 |
| ERT-3 | 10.23 | 10.47 | 10.49 | 10.35 | 10.51 |
| ERT-4 | 9.58 | 9.77 | 9.75 | 9.43 | 9.83 |
| ERT-4A | 9.63 | 9.76 | 9.74 | 9.65 | 9.82 |
| ERT-5 | 9.56 | 9.77 | 9.79 | 9.65 | 9.84 |
| ERT-6 | 9.65 | 9.82 | 9.82 | 9.72 | 9.87 |
| ERT-7 | 9.61 | 9.73 | 9.71 | 9.58 | 9.75 |
| ERT-7A | 9.65 | 9.82 | 9.80 | 9.70 | 9.84 |
| ERT-8 | 9.53 | 9.70 | 9.69 | 9.56 | 9.73 |
| ERT-8A | 9.57 | 9.76 | 9.74 | 9.62 | 9.78 |
| ERT-9 | 9.09 | 9.63 | 9.65 | 9.53 | 9.76 |
| ERT-9A | 8.17 | 1.85 | 3.01 | 4.05 | 5.29 |
| ERT-10 | 9.44 | 9.68 | 9.68 | 9.59 | 9.74 |
| ERT-10A | 9.57 | 9.80 | 9.72 | 9.66 | 9.80 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 18.98 | 19.10 | 19.10 | 18.98 | 18.72 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.77 | 9.91 | 9.91 | 9.82 | 10.01 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023990

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 16-Dec-87 | 20-Dec-87 | 21-Dec-87 | 23-Dec-87 | 26-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 10.66 | 10.74 | 11.00 | 11.10 | 10.94 |
| ERT-1A | 9.44 | 9.65 | 9.83 | 9.97 | 9.83 |
| ERT-2 | 10.47 | 10.48 | 10.66 | 10.86 | 10.66 |
| ERT-3 | 10.31 | 10.29 | 10.53 | 10.65 | 10.47 |
| ERT-4 | 9.51 | 9.61 | 9.83 | 9.97 | 9.81 |
| ERT-4A | 9.56 | 9.73 | 10.41 | 9.95 | 9.69 |
| ERT-5 | 9.56 | 9.57 | 9.77 | 9.99 | 9.79 |
| ERT-6 | 9.70 | 9.67 | 9.80 | 10.06 | 9.84 |
| ERT-7 | 9.63 | 9.62 | 9.99 | 9.89 | 9.73 |
| ERT-7A | 9.76 | 9.74 | 10.06 | 9.96 | 9.86 |
| ERT-8 | 9.61 | 9.59 | 9.93 | 9.85 | 9.71 |
| ERT-8A | 9.67 | 9.60 | 10.20 | 9.90 | 9.81 |
| ERT-9 | 9.54 | 9.51 | 9.71 | 9.89 | 9.59 |
| ERT-9A | 8.17 | 2.21 | 3.75 | 5.85 | 7.65 |
| ERT-10 | 9.55 | 9.53 | 9.70 | 9.88 | 9.73 |
| ERT-10A | 9.64 | 9.62 | 9.84 | 9.94 | 9.80 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 19.10 | 18.92 | 19.38 | 19.40 | 19.24 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.84 | 9.75 | | 10.13 | 10.05 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023981

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 27-Dec-87 | 28-Dec-87 | 29-Dec-87 | 30-Dec-87 | 31-Dec-87 |
|---|---|---|---|---|---|
| ERT-1 | 10.92 | 10.96 | 10.86 | 11.11 | 11.14 |
| ERT-1A | 9.73 | 9.83 | 9.75 | 9.93 | 10.01 |
| ERT-2 | 10.52 | 10.64 | 10.60 | 10.80 | 10.85 |
| ERT-3 | 10.31 | 10.45 | 10.37 | 10.59 | 10.64 |
| ERT-4 | 9.74 | 9.83 | 9.73 | 10.93 | 10.01 |
| ERT-4A | 9.81 | 9.87 | 9.79 | 9.92 | 9.97 |
| ERT-5 | 9.69 | 9.77 | 9.67 | 9.92 | 9.97 |
| ERT-6 | 9.78 | 9.84 | 9.74 | 9.97 | 10.02 |
| ERT-7 | | 9.73 | 9.67 | 9.86 | 9.86 |
| ERT-7A | | 9.90 | 9.82 | 9.97 | 9.95 |
| ERT-8 | | 9.73 | 9.61 | 9.88 | 9.78 |
| ERT-8A | | 9.86 | 9.78 | 9.92 | 9.93 |
| ERT-9 | 9.69 | 9.63 | 9.59 | 8.85 | 9.96 |
| ERT-9A | 8.07 | 8.47 | 8.61 | 8.91 | 9.14 |
| ERT-10 | 9.68 | 9.68 | 9.62 | 9.79 | 9.92 |
| ERT-10A | | 9.80 | 9.72 | 9.92 | 9.95 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | 19.26 | 19.16 | 19.38 | 19.44 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | 9.99 | 9.89 | 10.12 | 10.22 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

02-0932

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 01-Jan-88 | 02-Jan-88 | 03-Jan-88 | 04-Jan-88 | 17-Jan-88 |
|---|---|---|---|---|---|
| ERT-1 | 10.98 | 10.96 | 11.10 | 10.93 | |
| ERT-1A | 9.87 | 9.76 | 8.98 | 9.82 | |
| ERT-2 | 10.72 | 10.74 | 10.83 | 10.63 | 10.78 |
| ERT-3 | 10.49 | 10.47 | 10.61 | 10.40 | 10.61 |
| ERT-4 | 9.86 | 9.78 | 9.99 | 9.80 | |
| ERT-4A | 9.85 | 9.85 | 9.94 | 9.78 | |
| ERT-5 | 9.81 | 9.81 | 9.92 | 9.74 | 9.89 |
| ERT-6 | 9.85 | 9.78 | 9.97 | 9.77 | 9.92 |
| ERT-7 | 9.76 | 9.73 | 9.83 | 9.65 | 9.83 |
| ERT-7A | 9.91 | 9.93 | 9.96 | 9.82 | 9.96 |
| ERT-8 | 9.73 | 9.73 | 9.83 | 9.68 | 9.82 |
| ERT-8A | 9.86 | 9.80 | 9.91 | 9.79 | 9.99 |
| ERT-9 | 9.77 | 9.64 | 9.86 | 9.71 | 9.91 |
| ERT-9A | 9.31 | 9.26 | 9.51 | 9.55 | 9.74 |
| ERT-10 | 9.76 | 9.68 | 9.90 | 9.78 | 9.90 |
| ERT-10A | 9.84 | 9.80 | 10.01 | 9.84 | 9.96 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 18.58 | 18.58 | 19.42 | 19.25 | 19.41 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 10.04 | 9.99 | 10.15 | 10.03 | |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023983

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 18-Jan-88 | 19-Jan-88 | 20-Jan-88 | 21-Jan-88 | 22-Jan-88 |
|---|---|---|---|---|---|
| ERT-1 | 11.10 | 11.07 | 10.78 | 10.79 | 10.81 |
| ERT-1A | 10.09 | 10.17 | 9.91 | 9.80 | 9.75 |
| ERT-2 | 10.88 | 10.84 | 10.48 | 10.50 | 10.52 |
| ERT-3 | 10.93 | 10.25 | 10.60 | 10.27 | 10.28 |
| ERT-4 | 9.97 | 9.99 | 9.65 | 9.69 | 9.71 |
| ERT-4A | 10.01 | 8.99 | 9.67 | 9.66 | 9.72 |
| ERT-5 | 9.97 | 9.97 | 9.55 | 9.61 | 9.59 |
| ERT-6 | 10.32 | 9.97 | 9.60 | 9.65 | 9.64 |
| ERT-7 | 9.95 | 9.94 | 8.59 | 6.63 | 9.64 |
| ERT-7A | 10.08 | 9.88 | 9.83 | 9.84 | 9.77 |
| ERT-8 | 9.91 | 9.93 | 9.55 | 9.57 | 9.60 |
| ERT-8A | 10.07 | 10.18 | 9.83 | 9.83 | 9.74 |
| ERT-9 | 9.98 | 10.07 | 9.60 | 9.51 | 9.64 |
| ERT-9A | 9.84 | 9.85 | 9.35 | 4.70 | 8.92 |
| ERT-10 | 10.00 | 10.04 | 10.04 | 9.66 | 9.68 |
| ERT-10A | 10.02 | 10.01 | 9.72 | 9.80 | 9.86 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 19.47 | 19.51 | 19.08 | 19.17 | 19.00 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | | | | | 9.69 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

023984

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL | | | | |
|---|---|---|---|---|---|
| WELL | 23-Jan-88 | 24-Jan-88 | 03-Feb-88 | 04-Feb-88 | 09-Feb-88 |
| ERT-1 | 10.88 | 10.88 | | 10.68 | 10.92 |
| ERT-1A | 9.94 | 9.94 | 9.77 | 9.81 | |
| ERT-2 | 10.76 | | | 10.43 | 10.60 |
| ERT-3 | 10.51 | | | 10.19 | 10.32 |
| ERT-4 | 9.86 | 9.86 | | 9.60 | 9.79 |
| ERT-4A | 9.91 | 9.91 | 9.73 | | 9.80 |
| ERT-5 | 9.85 | | | 9.35 | 9.70 |
| ERT-6 | 9.88 | | | 9.52 | 9.74 |
| ERT-7 | 9.83 | 9.83 | 9.66 | | 9.77 |
| ERT-7A | 9.94 | 9.94 | 9.72 | | 9.85 |
| ERT-8 | 9.79 | 9.79 | | 9.57 | 9.73 |
| ERT-8A | 9.92 | 9.92 | 9.58 | | 9.81 |
| ERT-9 | 9.86 | 9.86 | 9.66 | | 9.77 |
| ERT-9A | 9.46 | 9.46 | 9.57 | | 9.70 |
| ERT-10 | 9.90 | 9.90 | 9.72 | | 9.83 |
| ERT-10A | 9.92 | 9.92 | 9.80 | | 9.84 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 19.08 | 19.08 | | 18.79 | 18.56 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 9.81 | 9.81 | | | 10.89 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

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FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 11-Feb-88 | 12-Feb-88 | 13-Feb-88 | 14-Feb-88 | 15-Feb-88 |
|---|---|---|---|---|---|
| ERT-1 | 10.82 | 10.81 | 10.83 | 10.84 | 10.82 |
| ERT-1A | 9.75 | 9.68 | 9.91 | 9.89 | 9.73 |
| ERT-2 | 10.54 | 10.50 | 10.52 | 10.56 | 10.52 |
| ERT-3 | 10.29 | 10.23 | 10.21 | 10.25 | 10.27 |
| ERT-4 | 9.73 | 9.68 | 9.72 | 9.68 | 9.71 |
| ERT-4A | 9.71 | 9.67 | 9.70 | 9.74 | 9.71 |
| ERT-5 | 9.59 | 9.58 | 9.61 | 9.71 | 9.60 |
| ERT-6 | 9.64 | 9.60 | 9.60 | 9.66 | 9.68 |
| ERT-7 | 9.65 | 9.63 | 9.63 | 9.67 | 9.67 |
| ERT-7A | 9.82 | 9.76 | 9.77 | 9.77 | 9.86 |
| ERT-8 | 9.61 | 9.57 | 9.58 | 9.57 | 9.63 |
| ERT-8A | 9.78 | 9.75 | 9.76 | 9.78 | 9.82 |
| ERT-9 | 9.65 | 9.65 | 9.66 | 9.68 | 9.67 |
| ERT-9A | 9.65 | 9.55 | 9.49 | 9.53 | 9.53 |
| ERT-10 | 9.71 | 9.68 | 9.68 | 9.76 | 9.68 |
| ERT-10A | 9.84 | 9.74 | 9.74 | 9.72 | 9.78 |
| ERT-20 | | | | | |
| ERT-21 | | | | | |
| ERT-22 | | | | | |
| ERT-23 | | | | | |
| ERT-24 | | | | | |
| ERT-25 | | | | | |
| ERT-26 | | | | | |
| ERT-27 | | | | | |
| ERT-28 | | | | | |
| ERT-29 | | | | | |
| ERT-30 | | | | | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 19.06 | 19.08 | 19.10 | 19.59 | 19.08 |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | | | | |
| REI-10-3 | 10.09 | 9.91 | 9.91 | 9.21 | 9.95 |
| REI-10-4 | | | | | |
| REI-12-2 | | | | | |

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 18-Feb-88 | 03-Mar-88 | 16-Mar-88 | 29-Mar-88 | 02-Apr-88 |
|---|---|---|---|---|---|
| ERT-1 | 10.88 | 10.82 | 10.90 | 11.24 | 11.13 |
| ERT-1A | 9.73 | 9.87 | 9.79 | 10.18 | 10.05 |
| ERT-2 | 10.56 | 10.70 | | 10.62 | 10.65 |
| ERT-3 | 10.29 | 10.28 | | 10.75 | 10.55 |
| ERT-4 | 9.69 | 9.73 | 9.79 | 9.99 | 10.06 |
| ERT-4A | 9.73 | 9.89 | 9.83 | 9.95 | 10.01 |
| ERT-5 | 9.59 | 9.55 | | 9.71 | 9.85 |
| ERT-6 | 9.70 | 9.64 | | 10.10 | 9.91 |
| ERT-7 | 9.71 | 9.92 | 9.61 | 9.71 | 9.85 |
| ERT-7A | 9.86 | 10.10 | 9.82 | 9.86 | 9.99 |
| ERT-8 | 9.67 | 9.41 | 9.74 | 10.09 | 9.88 |
| ERT-8A | 9.79 | 9.70 | 9.76 | 9.80 | 9.95 |
| ERT-9 | 9.76 | 9.87 | 9.66 | 9.84 | 10.01 |
| ERT-9A | 9.61 | 9.79 | 9.52 | 9.73 | 9.96 |
| ERT-10 | 9.77 | 9.90 | 9.69 | 10.36 | 9.97 |
| ERT-10A | 9.80 | 9.70 | 9.72 | 9.92 | 10.10 |
| ERT-20 | | 10.15 | | 10.21 | |
| ERT-21 | | 9.59 | | 6.53 | |
| ERT-22 | | 9.54 | | 9.58 | |
| ERT-23 | | 9.77 | | 9.99 | |
| ERT-24 | | 9.97 | | 9.59 | |
| ERT-25 | | | | | 10.07 |
| ERT-26 | | | | | 10.22 |
| ERT-27 | | | | | 11.63 |
| ERT-28 | | | | | 6.77 |
| ERT-29 | | | | | 10.40 |
| ERT-30 | | | | | 4.91 |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | 19.16 | | | | |
| REI-3-1 | | | | | |
| REI-3-2 | | | | | |
| REI-3-3 | | | | | |
| REI-5 | | | | | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | | 9.48 | 9.52 | 9.48 | 10.88 |
| REI-10-3 | 10.34 | | 9.79 | 10.01 | 10.11 |
| REI-10-4 | | 9.86 | 9.77 | 10.24 | 10.15 |
| REI-12-2 | | | | | |

# FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 11-Apr-88 | 13-Apr-88 | 25-Apr-88 | 07-May-88 | 14-May-88 |
|---|---|---|---|---|---|
| ERT-1 | 10.88 | 10.86 | 10.65 | 9.57 | 9.43 |
| ERT-1A | 9.82 | 9.76 | 9.55 | 9.59 | 9.57 |
| ERT-2 | 10.54 | | 10.37 | 9.60 | 9.54 |
| ERT-3 | 10.43 | | 10.09 | 9.56 | 9.58 |
| ERT-4 | 9.75 | 9.71 | 9.52 | 9.60 | 9.53 |
| ERT-4A | 9.79 | 9.76 | 9.55 | 9.60 | 9.53 |
| ERT-5 | 9.80 | | 9.45 | 9.56 | 9.56 |
| ERT-6 | 9.72 | | 9.50 | 9.61 | 9.50 |
| ERT-7 | 9.65 | 9.67 | 9.44 | 9.51 | 9.48 |
| ERT-7A | 9.86 | 9.83 | 9.57 | 9.59 | 9.55 |
| ERT-8 | 9.69 | 9.63 | 9.42 | 9.50 | 9.51 |
| ERT-8A | 9.80 | 9.78 | 9.54 | 9.56 | 9.42 |
| ERT-9 | 9.71 | 9.76 | 9.52 | 9.58 | 9.56 |
| ERT-9A | 9.76 | 9.63 | 9.53 | 9.77 | 9.82 |
| ERT-10 | 9.74 | 9.41 | 9.51 | 9.57 | 9.58 |
| ERT-10A | 9.82 | 9.80 | 9.60 | 9.63 | 9.53 |
| ERT-20 | 10.04 | | 9.34 | | |
| ERT-21 | 9.56 | | 9.17 | | |
| ERT-22 | 9.55 | | 9.30 | | |
| ERT-23 | 9.98 | | 9.71 | | |
| ERT-24 | 9.79 | | 9.52 | | |
| ERT-25 | 9.85 | | 9.58 | | |
| ERT-26 | 10.12 | | 9.54 | | |
| ERT-27 | 11.38 | | 10.76 | | |
| ERT-28 | 7.46 | | 8.55 | | |
| ERT-29 | 10.46 | | 10.02 | | |
| ERT-30 | 4.71 | | 4.09 | | |
| GW-2 | 4.53 | | | | |
| GW-7 | 11.16 | | | | |
| GW-8 | 8.21 | | | | |
| GW-9 | 15.00 | | | | |
| GW-13 | 9.37 | | | | |
| GW-17 | 9.77 | | | | |
| GW-18 | 12.40 | | | | |
| GW-19 | 10.14 | | | | |
| GW-23 | 6.85 | | | | |
| REI-1 | 17.47 | | | | |
| REI-3-1 | 9.32 | | | | |
| REI-3-2 | 8.52 | | | | |
| REI-3-3 | 9.17 | | | | |
| REI-5 | 10.63 | | | | |
| REI-6-1 | 9.82 | | | | |
| REI-6-2 | 9.87 | | | | |
| REI-8 | 9.60 | | | | |
| REI-9 | 7.18 | | | | |
| REI-10-2 | 9.56 | 9.50 | 9.28 | 9.36 | 9.39 |
| REI-10-3 | 9.96 | 9.73 | 9.58 | 7.97 | 7.93 |
| REI-10-4 | 9.94 | 9.92 | 9.68 | 9.35 | 9.27 |
| REI-12-2 | 8.16 | | | | |

FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 24-May-88 | 28-May-88 | 07-Jun-88 | 20-Jun-88 | 24-Jun-88 |
|---|---|---|---|---|---|
| ERT-1 | 9.26 | 9.09 | 9.08 | | 8.68 |
| ERT-1A | 9.25 | 9.10 | 9.07 | | 8.57 |
| ERT-2 | 9.24 | 9.09 | 9.07 | 9.02 | 8.72 |
| ERT-3 | 9.25 | 9.11 | 9.10 | 8.55 | 8.83 |
| ERT-4 | 9.25 | 9.08 | 9.08 | 9.67 | 8.73 |
| ERT-4A | 9.31 | 9.11 | 9.08 | 8.89 | 8.75 |
| ERT-5 | 9.23 | 9.06 | 9.05 | 9.61 | 8.73 |
| ERT-6 | 9.30 | 9.10 | 9.10 | 8.80 | 8.80 |
| ERT-7 | 9.15 | 8.95 | 9.05 | 8.61 | 8.56 |
| ERT-7A | 9.24 | 9.04 | 9.12 | 8.66 | 8.58 |
| ERT-8 | 9.15 | 8.91 | 9.07 | 8.51 | 8.49 |
| ERT-8A | 9.24 | 9.03 | 9.21 | 8.68 | 8.58 |
| ERT-9 | 9.25 | 9.07 | 9.07 | 8.61 | 8.67 |
| ERT-9A | 9.41 | 9.25 | 9.26 | 8.79 | 8.91 |
| ERT-10 | 9.63 | 9.08 | 9.07 | 8.68 | 8.68 |
| ERT-10A | 9.38 | 9.15 | 9.20 | 9.20 | 8.70 |
| ERT-20 | 8.69 | | | 8.06 | |
| ERT-21 | 8.77 | | | 7.20 | |
| ERT-22 | 8.98 | | | 8.37 | |
| ERT-23 | 9.35 | | | 8.83 | |
| ERT-24 | 9.21 | | | 8.73 | |
| ERT-25 | 8.98 | | | 8.52 | |
| ERT-26 | 8.82 | | | 8.60 | |
| ERT-27 | 10.25 | | | 9.97 | |
| ERT-28 | 7.93 | | 7.27 | | |
| ERT-29 | 8.97 | | | 8.47 | |
| ERT-30 | 3.65 | | | 2.98 | |
| GW-2 | | | | | |
| GW-7 | | | | | |
| GW-8 | | | | | |
| GW-9 | | | | | |
| GW-13 | | | | | |
| GW-17 | | | | | |
| GW-18 | | | | | |
| GW-19 | | | | | |
| GW-23 | | | | | |
| REI-1 | | | | | |
| REI-3-1 | 8.02 | | | 7.71 | |
| REI-3-2 | | | | | |
| REI-3-3 | 8.29 | 7.65 | | | |
| REI-5 | 9.55 | | | 8.87 | |
| REI-6-1 | | | | | |
| REI-6-2 | | | | | |
| REI-8 | | | | | |
| REI-9 | | | | | |
| REI-10-2 | 9.44 | 8.84 | 8.82 | 8.42 | 8.44 |
| REI-10-3 | 9.17 | 8.91 | 8.94 | 8.61 | 8.59 |
| REI-10-4 | 10.00 | 8.75 | 8.77 | 8.34 | 8.36 |
| REI-12-2 | | | | | |

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FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

| WELL | WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL 29-Jun-88 | 08-Jul-88 | 18-Jul-88 | 06-Sep-88 |
|---|---|---|---|---|
| ERT-1 | 8.59 | 8.41 | 8.08 | 9.08 |
| ERT-1A | 8.22 | 8.27 | 8.25 | 8.42 |
| ERT-2 | 8.62 | 8.42 | 8.20 | 9.11 |
| ERT-3 | 8.69 | 8.50 | 8.32 | 9.15 |
| ERT-4 | 9.70 | 8.40 | 8.15 | 9.08 |
| ERT-4A | 8.66 | 8.53 | 8.17 | |
| ERT-5 | 8.63 | 8.43 | 8.21 | 9.11 |
| ERT-6 | 8.70 | 8.50 | 8.30 | 9.13 |
| ERT-7 | 8.44 | 8.23 | 8.03 | 9.11 |
| ERT-7A | 8.48 | 8.23 | 8.01 | 9.06 |
| ERT-8 | 8.41 | 8.20 | 8.00 | 9.10 |
| ERT-8A | 8.50 | 8.26 | 7.14 | 9.05 |
| ERT-9 | 8.55 | 8.37 | 8.11 | 9.04 |
| ERT-9A | 8.75 | 8.55 | 8.35 | 9.17 |
| ERT-10 | 8.58 | 8.38 | 8.13 | 9.02 |
| ERT-10A | 8.62 | 8.44 | 8.14 | 9.01 |
| ERT-20 | | | 7.27 | 8.50 |
| ERT-21 | | | 7.41 | 8.89 |
| ERT-22 | | | 7.79 | 8.04 |
| ERT-23 | | | 8.15 | 9.00 |
| ERT-24 | | | 8.40 | 9.03 |
| ERT-25 | | | 8.29 | 9.01 |
| ERT-26 | | | 8.04 | 8.77 |
| ERT-27 | | | 6.22 | 9.46 |
| ERT-28 | | | 6.32 | 5.87 |
| ERT-29 | | | 7.47 | 7.69 |
| ERT-30 | | | 2.34 | 2.72 |
| GW-2 | | | | |
| GW-7 | | | | |
| GW-8 | | | | |
| GW-9 | | | | |
| GW-13 | | | | |
| GW-17 | | | | |
| GW-18 | | | | |
| GW-19 | | | | |
| GW-23 | | | | |
| REI-1 | | | | |
| REI-3-1 | | | 0.03 | -1.35 |
| REI-3-2 | | | | |
| REI-3-3 | | | 3.92 | |
| REI-5 | | | 9.74 | 8.36 |
| REI-6-1 | | | | |
| REI-6-2 | | | | |
| REI-8 | | | | |
| REI-9 | | | | |
| REI-10-2 | 8.34 | 8.34 | | |
| REI-10-3 | 8.48 | 8.28 | 8.01 | 8.93 |
| REI-10-4 | 8.25 | 8.24 | 8.00 | 8.94 |
| REI-12-2 | | | | |

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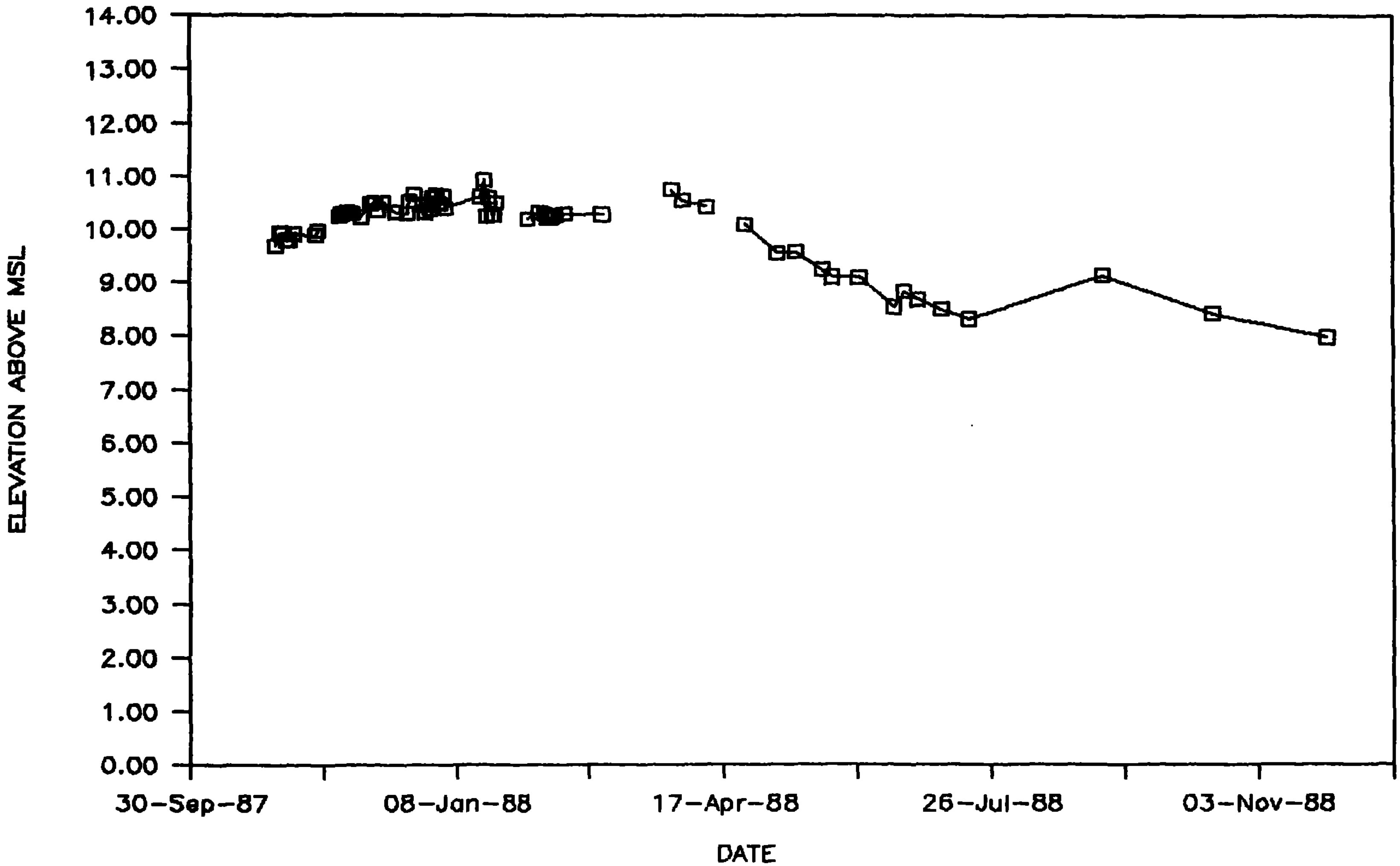
FRENCH LIMITED WATER LEVEL ELEVATIONS BY DATES

WATER LEVEL ELEVATION ABOVE MEAN SEA LEVEL

| WELL | 17-Oct-88 | 16-Nov-88 | 29-Nov-88 |
|---|---|---|---|
| ERT-1 | 8.41 | | |
| ERT-1A | | | 7.42 |
| ERT-2 | | | 7.92 |
| ERT-3 | 8.43 | | 7.99 |
| ERT-4 | | | 12.00 |
| ERT-4A | | | 7.76 |
| ERT-5 | | | 7.96 |
| ERT-6 | | | 7.97 |
| ERT-7 | | | 8.13 |
| ERT-7A | | | 8.06 |
| ERT-8 | 8.31 | | 8.06 |
| ERT-8A | | | 8.06 |
| ERT-9 | | | 8.04 |
| ERT-9A | | | 8.17 |
| ERT-10 | 8.43 | | 8.03 |
| ERT-10A | | | 8.03 |
| ERT-20 | 7.49 | | 7.35 |
| ERT-21 | 8.15 | | 7.97 |
| ERT-22 | 8.40 | | 8.15 |
| ERT-23 | 8.32 | | 7.92 |
| ERT-24 | 8.28 | | 7.89 |
| ERT-25 | 8.52 | | 8.06 |
| ERT-26 | 8.02 | | 7.69 |
| ERT-27 | 8.85 | | 8.56 |
| ERT-28 | 5.32 | | 3.96 |
| ERT-29 | 7.16 | | 6.78 |
| ERT-30 | 2.30 | | 1.91 |
| GW-2 | | | |
| GW-7 | | | |
| GW-8 | | | |
| GW-9 | | | |
| GW-13 | | | |
| GW-17 | | | |
| GW-18 | | | |
| GW-19 | | | |
| GW-23 | | | |
| REI-1 | | | |
| REI-3-1 | | | |
| REI-3-2 | | | |
| REI-3-3 | | | |
| REI-5 | | | |
| REI-6-1 | | | |
| REI-6-2 | | | |
| REI-8 | | | |
| REI-9 | | | |
| REI-10-2 | | | 7.85 |
| REI-10-3 | 8.27 | | 6.35 |
| REI-10-4 | 8.15 | | 7.91 |
| REI-12-2 | | | |

# WATER LEVEL ELEVATIONS, WELL ERT-3

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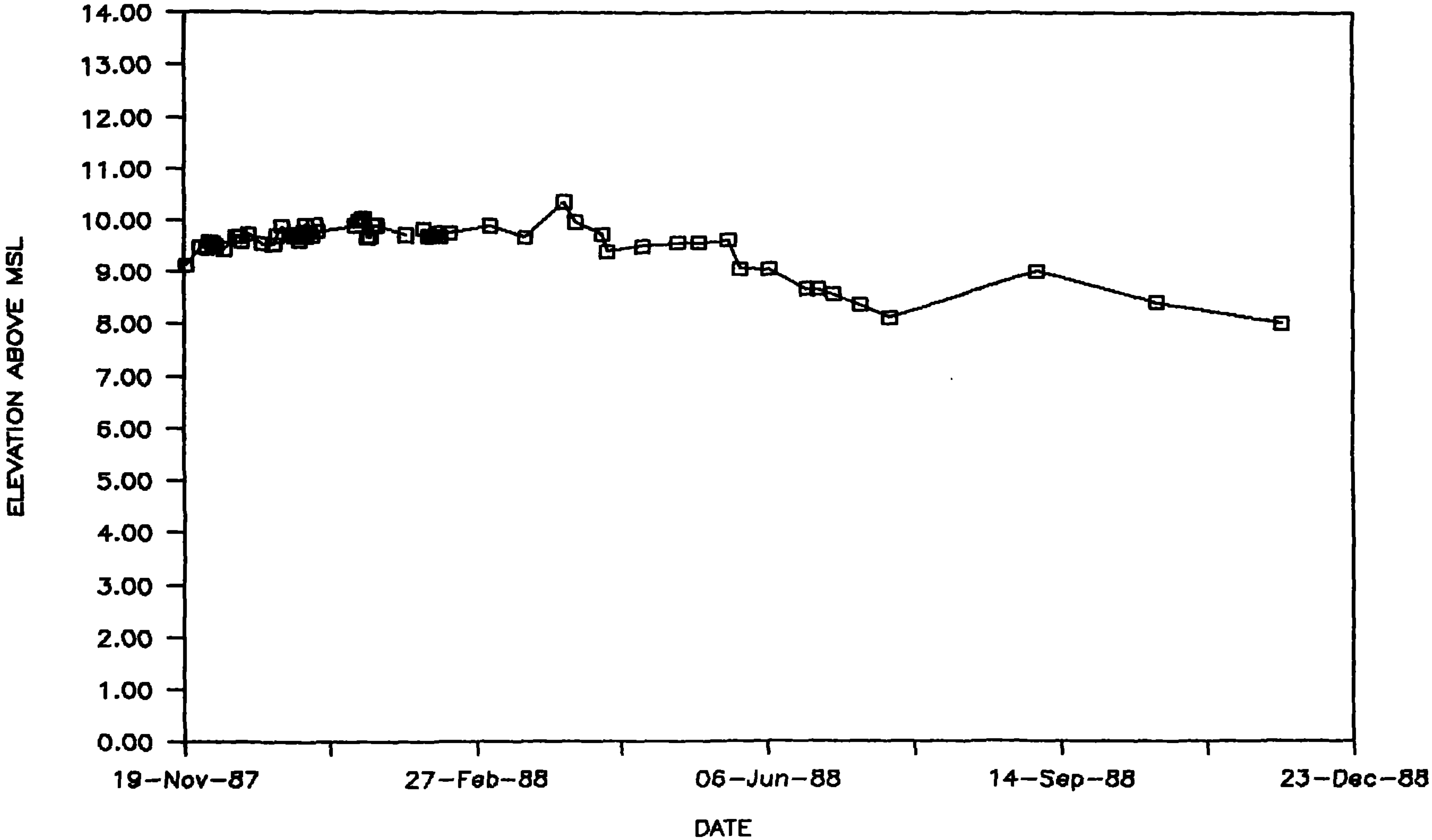
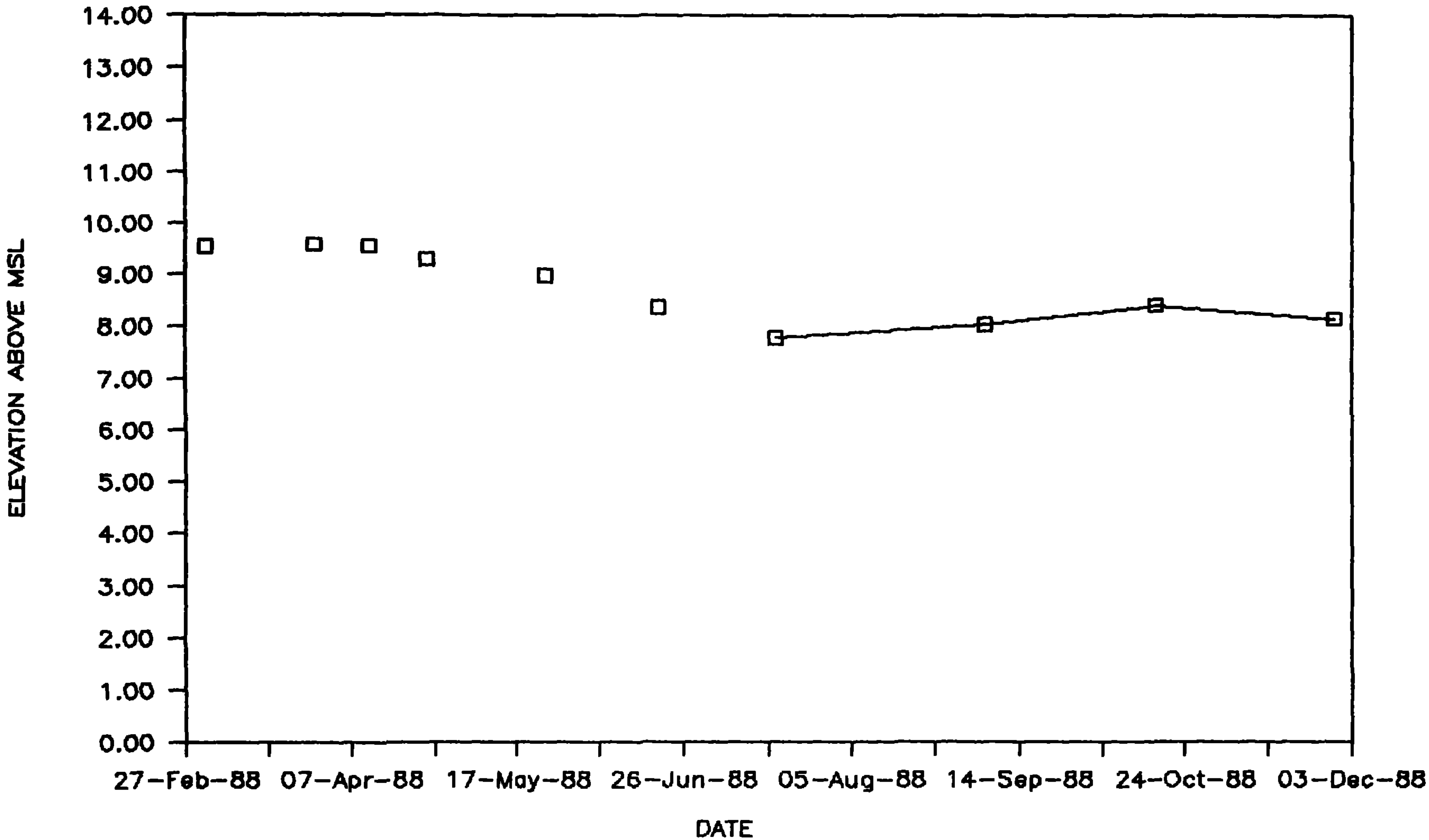
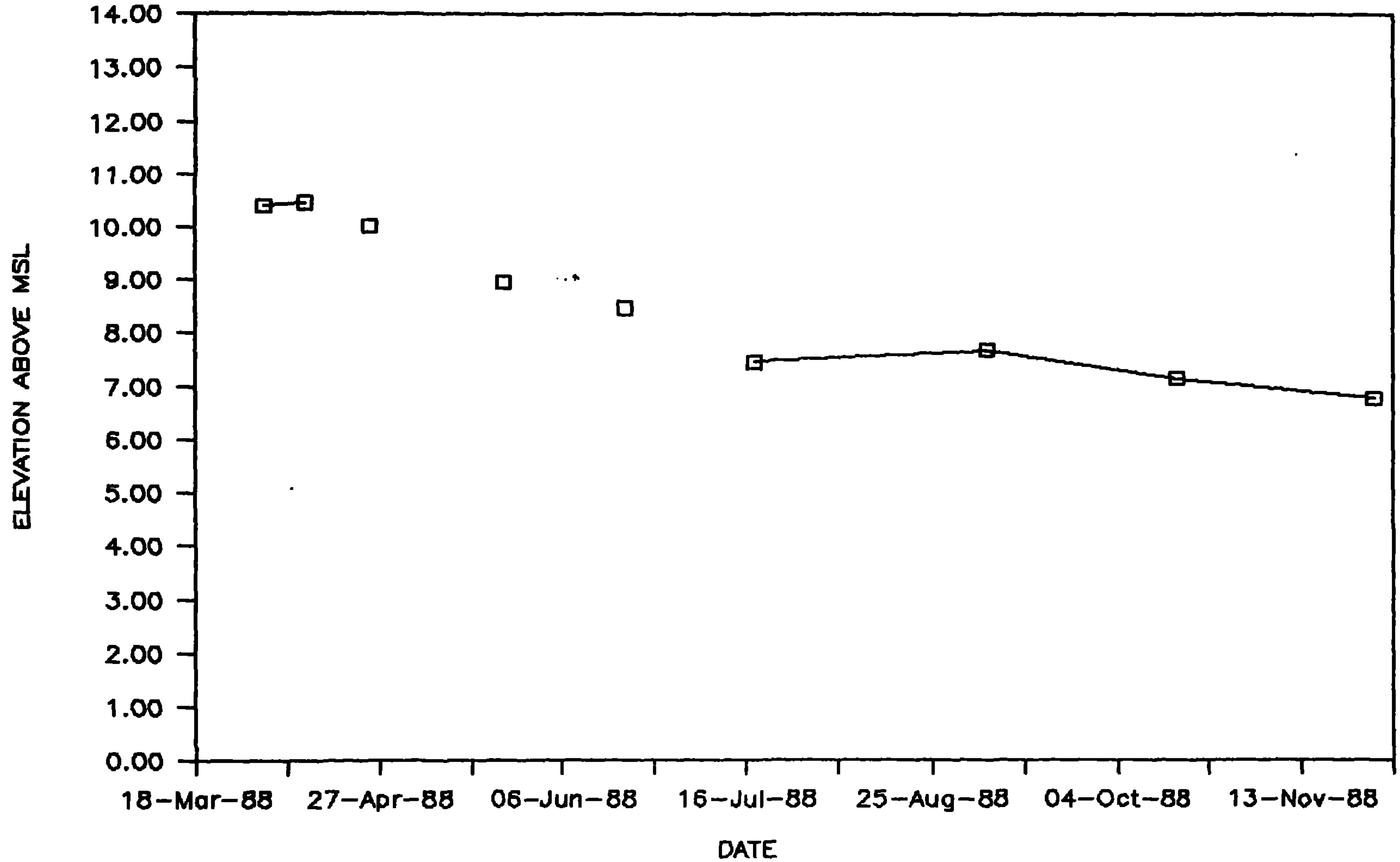
# WATER LEVEL ELEVATIONS, WELL ERT-10



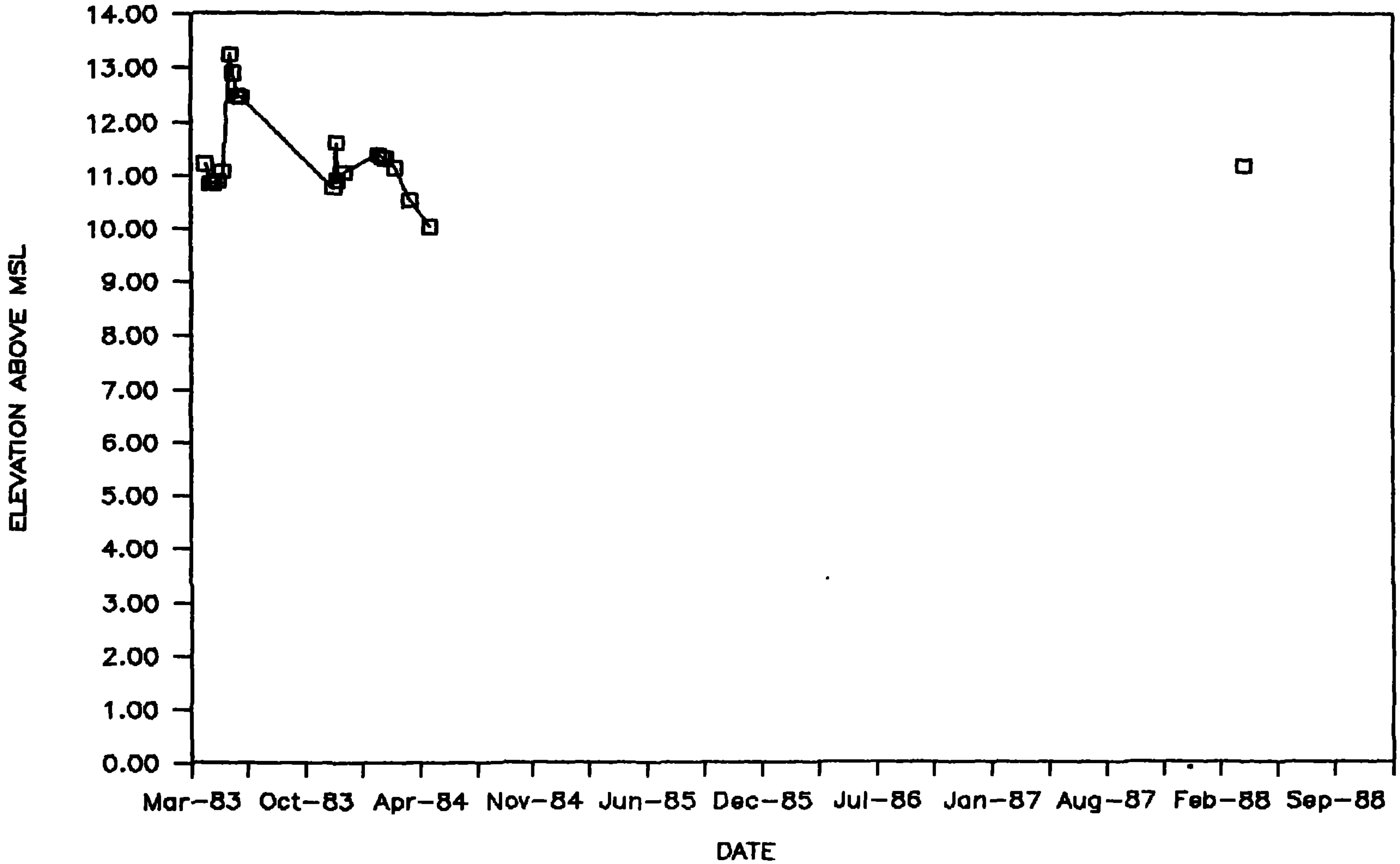
WATER LEVEL ELEVATIONS, WELL ERT-22



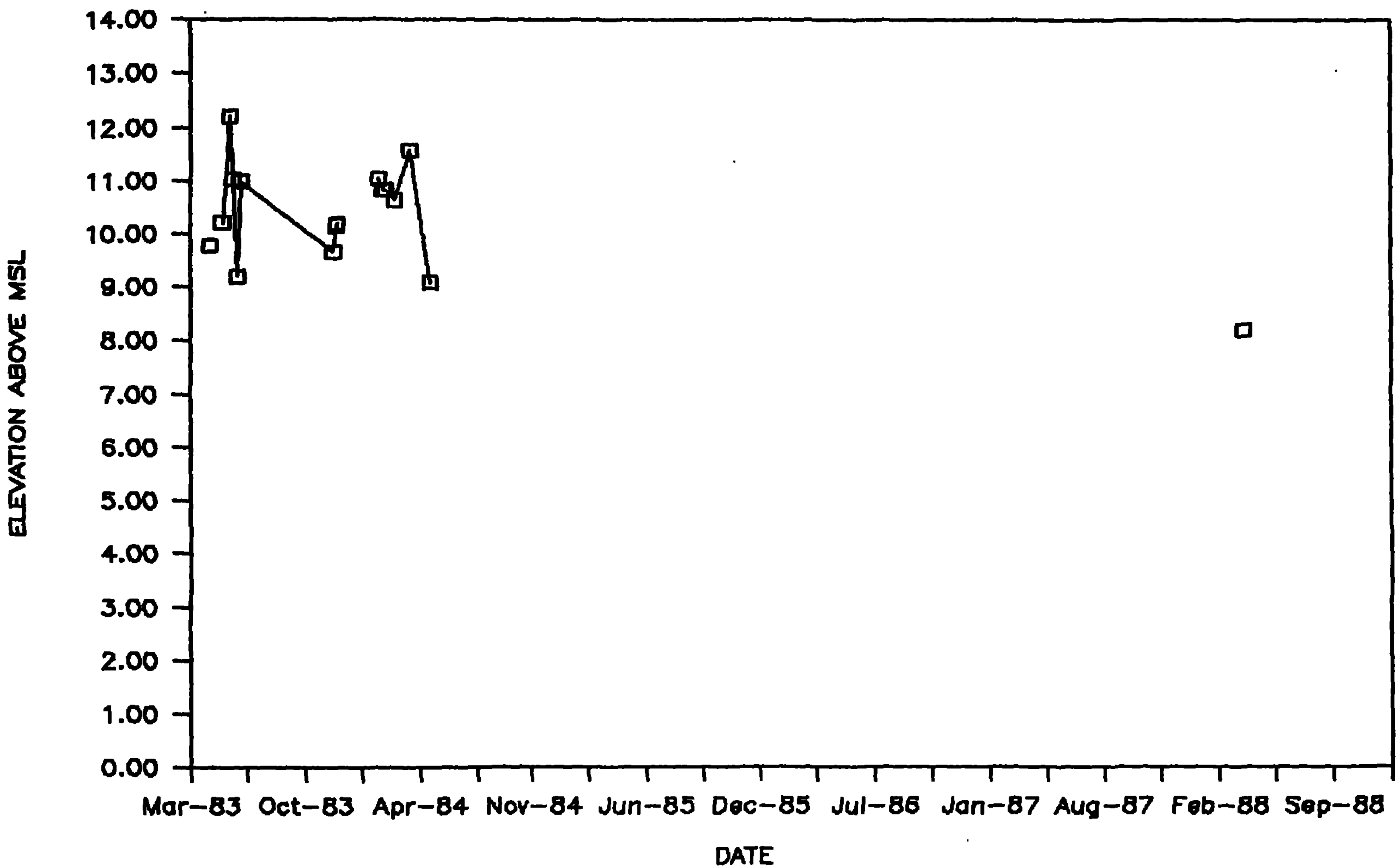
WATER LEVEL ELEVATIONS, WELL ERT-29



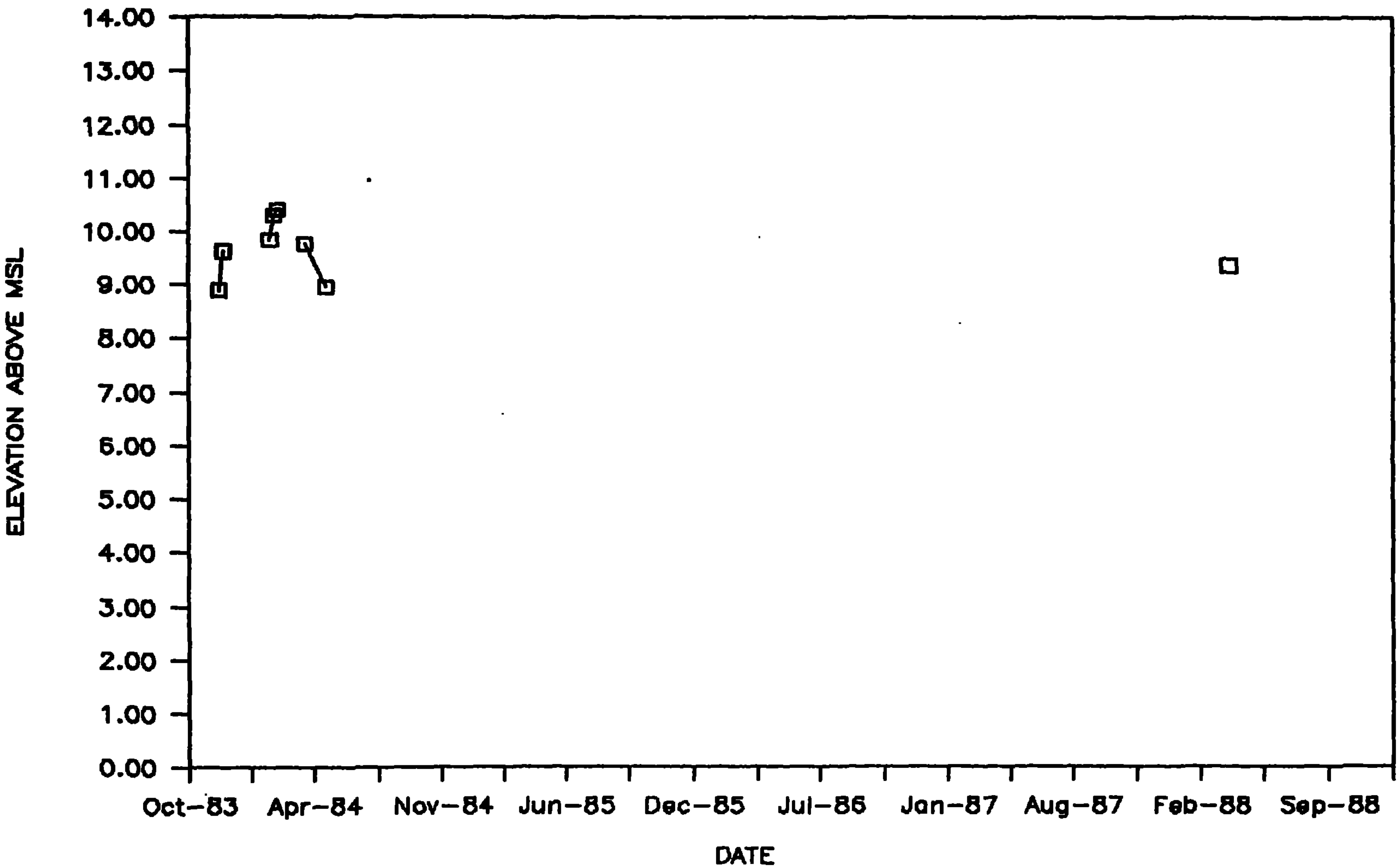
WATER LEVEL ELEVATIONS, WELL GW-7



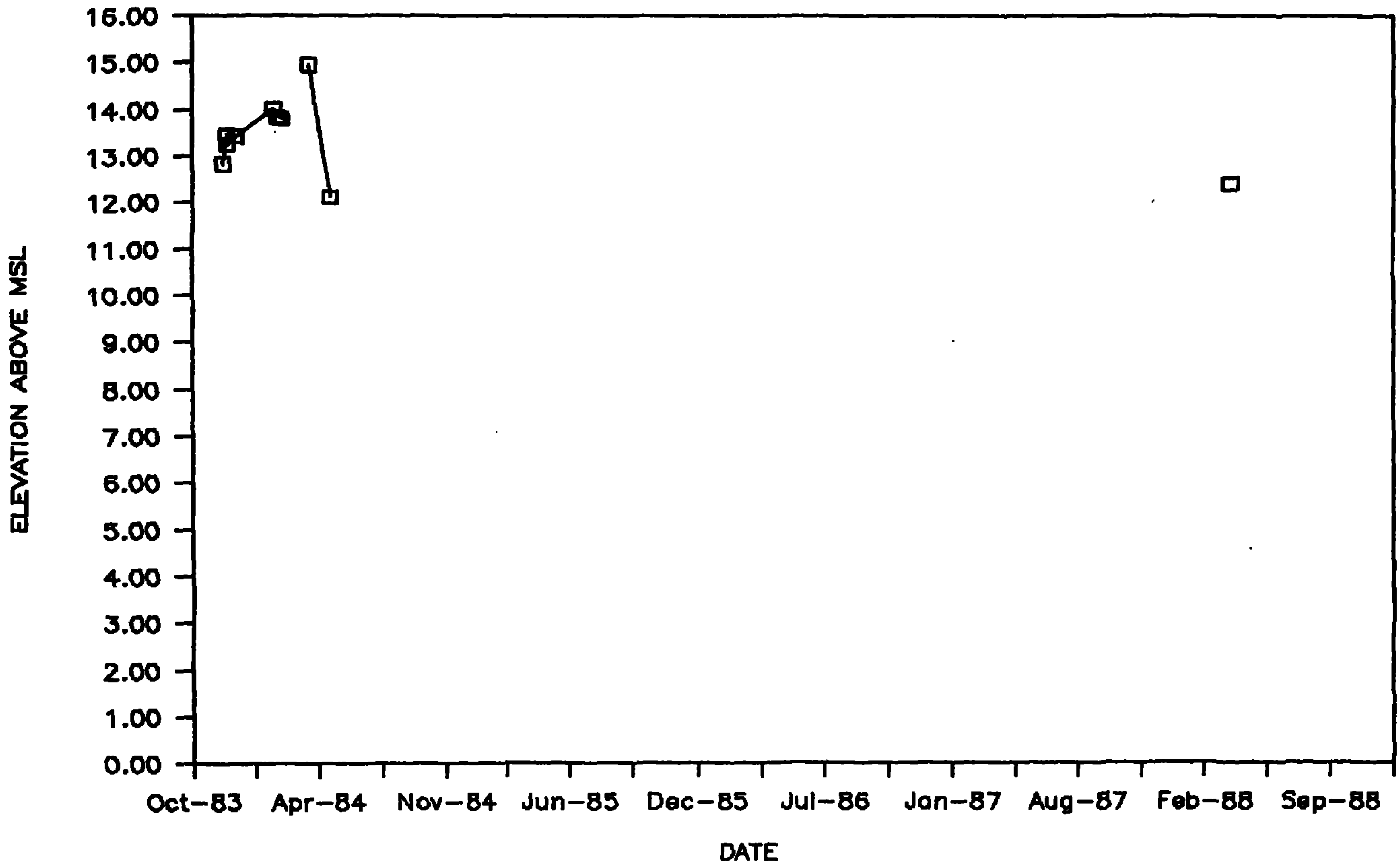
# WATER LEVEL ELEVATIONS, WELL GW-8



# WATER LEVEL ELEVATIONS, WELL GW-13



WATER LEVEL ELEVATIONS, WELL GW-18



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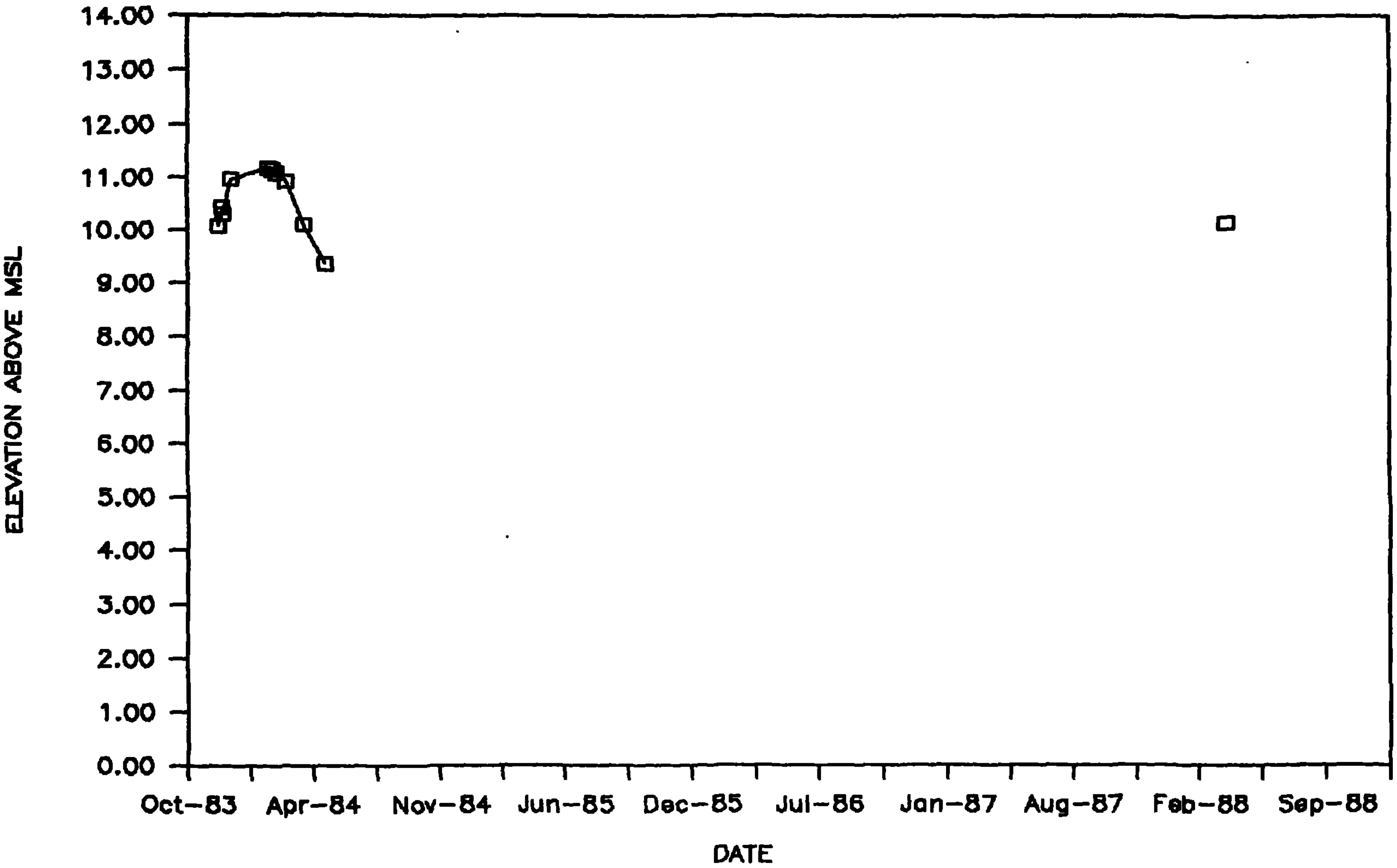
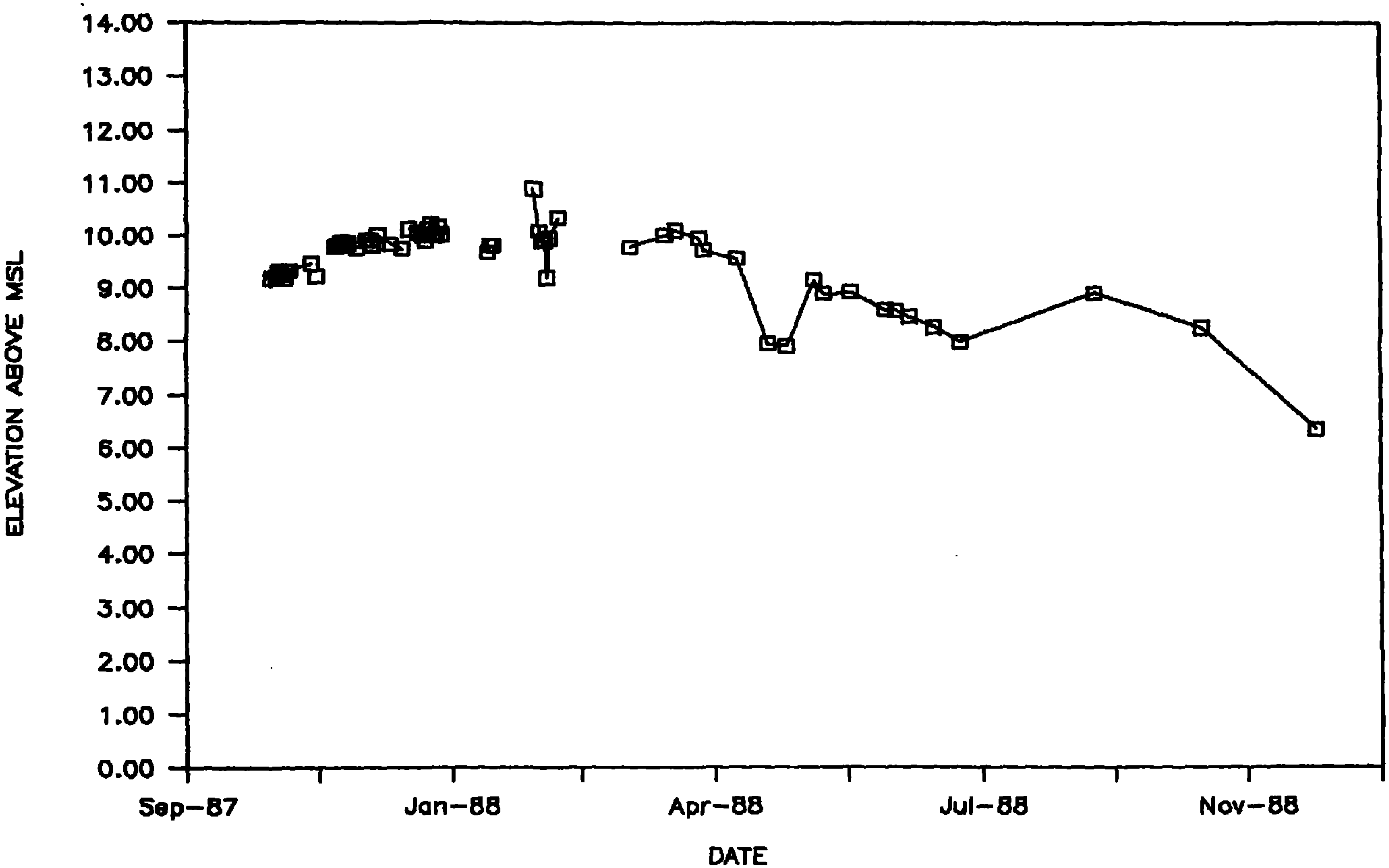
WATER LEVEL ELEVATIONS, WELL GW-19



WATER LEVEL ELEVATIONS, WELL REI-10-3



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